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Heat Pump Program
Programme des pompes de chaleur

Chemical Heat Pump Feasibility Study

Stearns Catalytic Ltd.

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CHEMICAL HEAT PUMP
FEASIBILITY STUDY

A Report prepared for the

Division of Energy
National Research Council of Canada

APRIL 1984

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SUMMARY

A chemical heat pump application using lithium bromide solution as a working fluid, was designed to recover 25.2 MM BTU/HR of waste heat from a distillation tower at Sunoco's, Sarnia Refinery and was costed at $2.31 million. The recovered heat was used to make medium pressure steam and this saving gave a payback period of 3.5 years.

Though not financially attractive at present, this heat pump has many advantages and its use should be encouraged.

RÉSUMÉ

On a conçu une pompe de chaleur chimique dont le fluide caloporteur est une solution de bromure de lithium, et qui est destiné à récupérer 25,2 MM BTU/h de chaleur rejetée par une tour de distillation à la raffinerie de la Sunoco, à Sarnia. Le coût de cette pompe de chaleur s'élève à 2,31 millions de dollars. La chaleur récupérée a été utilisée pour produire de la vapeur sous pression moyenne; avec ces économies, les coûts sont amortis sur une période de 3,5 ans.

Cette pompe de chaleur n'est pas financièrement attrayante actuellement; néanmoins, elle possède de nombreux avantages et son utilisation devrait être encouragée.

1. VAPOUR COMPRESSION HEAT PUMP EXPERIENCE

The following 3 projects for Dome Petroleum indicate Stearns Catalytic's industrial experience with vapour compression heat pumps.

Natural Gas Liquids Fractionation Facilities
Sarnia, Ontario
Dome Petroleum

Phase IV

Phase IV involved the design and construction of Fractionation Facilities for separate C1 thru C5 feedstock at a rate of 30,000 BPD. This Phase proved to be a challenge for Stearns Catalytic due to the requirement of innovative design concepts and the short schedule of 1 year. Over 150 major pieces of equipment were required for this project. This included a Butane Splitter of 10,000 BPD capacity utilizing a prototype vapour recompression heat pump for energy conservation consisting of a 2500 HP Compressor and Aluminum Plate Fin Reboilers. This results in a saving of 35 MM BTU/HR which would have been supplied by natural gas.

Phase V

In this Phase Stearns Catalytic had to retrofit the Phase III - 18,000 BPD Butane Splitter and incorporate a heat pump circuit similar to that on Phase IV. This was accomplished with a 4500 HP Compressor but retrofitted conventional kettle type reboilers with Union Carbide High Flux tubes. This results in a saving of 73.6 MM BTU/HR.

Phase VI

Phase VI required the provision of an 18,000 BPD Butane Splitter in the shortest possible time. In less than 13 months this unit was operating. It featured a 14 foot diameter x 190 foot, 187 ton tower which was, at that time, Canada's largest shop fabricated vessel to be transported and erected in one piece. This unit in conjunction with some 40 major pieces of equipment incorporated a 4500 HP Compressor/Plate Fin Reboiler heat pump system. This results in a saving of 73.6 MM BTU/HR.

2. RESEARCH AND DEVELOPMENT FACILITIES

Stearns Catalytic's parent company, Air Products & Chemicals, Inc. of Allentown, Pa. is equipped with extensive research and development facilities in areas of cryogenic gas production and coal processing. These facilities are available on a consulting basis and further information on this will be forwarded.

While Stearns Catalytic have no laboratories engaged in R & D work in Canada, excellent results have been obtained by subcontracting this work to local universities. The following is a recent project conducted for the DSS.

Bench Scale Testing Program
Coal Cleaning by Chemical Comminution
Department of Supply and Services, Canada

Stearns Catalytic together with the University of Waterloo undertook a bench scale study to determine whether a process developed by the Syracuse Research Corporation for the chemical comminution for sulfur and ash removal is effective for Canadian coals.

The study conducted at the University of Waterloo, included the investigation of the chemical comminution of three selected Canadian coals from commercially significant seams to establish:

1. Particle size distribution after chemical comminution with ammonia and for mechanical grinding in a ball or hammer mill;

2. The effect of NH_3 partial pressure, treatment temperature and contact time on particle size distribution;

3. Relation of sulfur and ash removal in subsequent washing and heavy media separation operations to the practical size distributions achieved in 1. and 2.;

4. Relation of NH_3 consumption to sulfur and ash removal for the tests in 1. and 2.;

5. Distribution of NH_3 between coal and water phases after washing and heavy media separation.

Stearns Catalytic's principal process engineer co-ordinated the project throughout and co-authored the final report.

3. INTRODUCTION

3.1 Description

A heat pump is used to induce a flow of heat from a colder body to a warmer body, or to raise the temperature of a heat source. With a chemical heat pump, a refrigerant vapour dissolves in a concentrated solution of a chemical and the heat of solution is liberated resulting in a temperature rise. When water vapour is dissolved in concentrated lithium bromide, or sulphuric acid, a 1000 BTU/LB of water vapour is liberated.

3.2 History

Lithium Bromide (LiBr) solution refrigeration units have been in common use for many years. In 1978 Battelle Memorial Institute of Columbus, Ohio converted a 180 ton LiBr absorption chiller for use as a 2 MM BTU/HR demonstration heat pump. The resulting technology was licensed by the Adolph Coors Company in 1983. This is probably the only proven technology available for a commercial sized absorption heat pump.

3.3 Operation

The absorption heat pump operates with waste heat in the range of 180° to 360°F. It produces an output temperature in the range of 250°F to 400°F. It is capable of boosting about 45% of the waste heat input to the output temperature, while the remaining 55% of the waste heat is rejected to a low temperature sink. The maximum economic temperature elevation is about 120°F.

The heat pump system consists of standard heat exchangers and a solution pump which provides good mechanical reliability with little technical sophistication and excellent turndown properties. It requires very little power to operate.

3. INTRODUCTION (continued)

3.4 Specific Application

There are many sources of low grade heat suitable for driving an absorptive type heat pump. Stearns Catalytic Ltd. (SCL) have concentrated on one type of heat source in this study, which is common to petroleum and petrochemical plant. This is the heat lost on a distillation tower overhead condenser.

The operation of a distillation tower requires that the latent heat of evaporation be removed from the overhead vapour. This latent heat removed is usually discarded to the cooling water system or to the air. An absorption heat pump can recover approximately 45% of this heat and produce steam or other heating medium.

4. COMPLETE DESCRIPTION OF WORK UNDERTAKEN

a) Philosophy Behind Specific Applications Chosen

The general philosophy was that the heat pump installation chosen for this study should have little or no interference with the process operation as the unit is still a prototype. The heat pump can be shut down and the process continue to operate in its original manner. This does not provide the cheapest installation, as part of the existing air cooler could probably be used as the new air cooler. It does mean that 100% reliability is not required in the heat pump design, so pumps have not been spared and the air cooler is not designed for the maximum summer temperature. With this philosophy the heat pump can not be held responsible for a loss of production and the consequent cost.

The heat recovered by the heat pump could have been used in a new toulene tower reboiler, but as there was little space available for this it was decided to make steam with the recovered heat.

This would reduce the number of process tie-ins. The steam would be used in the 185 PSIG medium pressure steam header.

Air cooling was used for the heat pump as Sunoco had little surplus cooling water available.

The toluene tower was chosen as the best application because of the high duty of the overhead condenser (25.2 MM BTU/HR of latent heat) and the high temperature of the overheads (260°F). In addition, there was adequate space available for the heat pump and air cooler local to the toulene tower.

Another possible application was considered which was the use of waste low pressure steam at 30 PSIG to produce useful steam at 70 PSIG. While this looked a good application, the toluene tower was chosen because of its slightly higher quantity of waste heat.

4. COMPLETE DESCRIPTION OF WORK UNDERTAKEN

a) Philosophy Behind Specific Applications Chosen (continued)

SCL preferred to use Coors to specify the items of equipment in the Industrial Temperature Booster (ITB) and have them fabricated in Canada. Failing this, SCL preferred to have Coors supply only the major equipment in the ITB. However, Coors would only consider supply of the ITB as a skid mounted package.

b) How Capital Cost Was Estimated

SCL prepared the piping and instrument diagrams (Exhibit D) showing the new equipment and the piping tie-ins with the existing plant from process flow diagrams supplied by Coors (Exhibit C). The best location for the new equipment was chosen from the existing plot plan and site visits to Sunoco. Piping layout drawings (Exhibit E) were produced to show the location of equipment and major piping runs. A study drawing of the structure required to support the equipment was used to estimate the civil and structural costs. Using these drawings and the detailed drawings of the existing plant, a material take off was done for the piping, fittings, insulation and electrical materials.

The equipment was specified and firm prices were obtained on all equipment by inquiring prices from vendors. (See Exhibit F for summary of bids). All other material costs used are current vendor prices.

Installation of material and equipment in the field will be subcontracted to local area union contractors on a lump sum basis with SCL acting as construction managers, providing supervision, inspection, planning and cost control.

Approximately 15% of the engineering has been completed to give a capital cost with an accuracy of $\pm$ 10%.

4.C - Summary of Capital Costs

CLSS 176 rev. 1

STEARNS CATALYTIC LTD.

SUMMARY SHEET

ESTIMATE/JOB No. 2432 DATE March 15, 1984

CUSTOMER SUPPLY AND SERVICES CANADA

LOCATION

DESCRIPTION CHEMICAL HEAT PUMP CASE I

MATERIAL	1,	613,	950		
SUBCONTRACTS AND SHOP LABOR - Including Field Labour		390,	500		
ALL RISK INSURANCE, LEGAL LIABILITY ETC.		6,	000		
FEDERAL TAX			750		
PROVINCIAL TAX			650		
TOTAL MATERIAL, SUBCONTRACTS & SHOP LABOR	2,	011,	850		
FIELD LABOR					
PAYROLL BURDEN					
TOTAL FIELD LABOR					
FIELD SUPERVISION					
FIELD OFFICE PERSONNEL		60,	300		
FIELD COST CONTROL AND PLANNING					
CONSTRUCTION EQUIPMENT AND TOOLS		30,	000		
TOTAL OTHER FIELD CHARGES		90,	300		
ENGINEERING					
ESTIMATING AND COST CONTROL					
PURCHASING, EXPEDITING AND SHOP INSPECTION					
PLANNING AND SCHEDULING		138,	680		
ACCOUNTING & DATA PROCESSING					
HOME OFFICE TRAVEL EXPENSE					
REPRODUCTIONS AND GENERAL SERVICES					
TOTAL HOME OFFICE EXPENSES		138,	680		
SUB-TOTAL	2,	240,	830		
OVERHEAD					
FEE 3%		67,	200		
TOTAL CHARGES	2,	308,	030		
CONTINGENCIES					
ESCALATION					
GRAND TOTAL	2,	308,	030		

REMARKS Accuracy of Estimate ±10%

ESTIMATE NO. 2432
DATE March 15, 1984
PAGE 2 OF 4

4.C - Summary of Capital Costs

S U B - S U M M A R Y

CUSTOMER SUPPLY AND SERVICES CANADA
LOCATION

CODE	DESCRIPTION	MATERIAL	LABOR	SUBCONTRACT
0100	FIRED HEATERS & BOILERS			
0200	STACKS			
0400	REACTORS & INTERNALS			
0500	TOWERS & INTERNALS			
0600	HEAT EXCHANGE EQUIPMENT	247,100	-0-	7,200
0700	COOLING TOWERS			
0800	VESSELS, TANKS, DRUMS & INTERNALS	16,400	-0-	2,400
0900	PUMPS & DRIVERS	8,200	-0-	1,000
1000	BLOWERS & COMPRESSORS			
1100	ELEVATORS, CONV., MTLS.,HANDG. EQUIP.			
1200	MISC. MECHANICAL EQUIPMENT			
2500	TANKAGE			
2800	FILTERS AND CENTRIFUGES			
2900	AGITATORS AND MIXERS			
3000	SCRUBBERS AND SEPARATORS			
3100	MACHINE TOOLS & MACH. SHOP EQUIP.			
3200	HEATING, VENTILATION, AIR COND., DUST CONT.			
3400	PACKAGE UNITS	1,210,000	-0-	16,500
	SUB-TOTAL - MAJOR EQUIPMENT	1,481,700		27,100
1300	PIPING	52,800	-0-	77,000
1400	SEWERS			
1500	INSTRUMENTATION	21,700	-0-	12,000
1600	ELECTRICAL	45,950	-0-	48,800
1700	CONCRETE	-0-	-0-	8,800
1800	STRUCTURAL STEEL			118,000
1900	FIREPROOFING			66,200
2000	BUILDINGS Temporary Facilities	3,000	-0-	2,000
2100	SITE DEVELOPMENT			
2200	INSULATION	-0-	-0-	19,900
2300	PAINTING & PROTECTIVE COATINGS	-0-	-0-	5,900
2400	FIELD TESTING	-0-	-0-	4,800
2600	CHEMICALS AND CATALYST			
2700	PILING			
3300	FIRE PROTECTION			
3500	MISC. FURNITURE FOR PLANT BLDGS.			
	SUB-TOTAL	1,605,150		390,500
3700	MISC. DIRECT CHARGES	8,800	-0-	-0-
3800	STOREHOUSE ACCOUNTS			
3900	CONSTRUCTION SUPPLIES AND PETTY TOOLS	-0-	-0-	-0-
5000	INSURANCE AND TAXES	7,400		
6000	SUPERVISION AND FIELD OFFICE		60,300	
6500	CONSTRUCTION EQUIPMENT & TOOLS	30,000	-0-	-0-
7000	HOME OFFICE EXPENSES	5,600	133,080	-0-
	TOTAL DIRECT COSTS			

4.C - Summary of Capital Costs

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STEARNS CATALYTIC LTD.

SUMMARY SHEET

ESTIMATE/JOB No. 2432 DATE March 15, 1984

CUSTOMER SUPPLY AND SERVICES CANADA

LOCATION

DESCRIPTION CHEMICAL HEAT PUMP CASE II

MATERIAL	1, 625, 250	
SUBCONTRACTS AND SHOP LABOR - Including Field Labour	383, 660	
ALL RISK INSURANCE, LEGAL LIABILITY ETC.	6, 000	
FEDERAL TAX	750	
PROVINCIAL TAX	650	
TOTAL MATERIAL, SUBCONTRACTS & SHOP LABOR	2, 016, 310	
FIELD LABOR		
PAYROLL BURDEN		
TOTAL FIELD LABOR		
FIELD SUPERVISION		
FIELD OFFICE PERSONNEL	60, 300	
FIELD COST CONTROL AND PLANNING		
CONSTRUCTION EQUIPMENT AND TOOLS	30, 000	
TOTAL OTHER FIELD CHARGES	90, 300	
ENGINEERING		
ESTIMATING AND COST CONTROL		
PURCHASING, EXPEDITING AND SHOP INSPECTION		
PLANNING AND SCHEDULING	141, 220	
ACCOUNTING & DATA PROCESSING		
HOME OFFICE TRAVEL EXPENSE		
REPRODUCTIONS AND GENERAL SERVICES		
TOTAL HOME OFFICE EXPENSES	141, 220	
SUB-TOTAL	2, 247, 830	
OVERHEAD		
FEE 3%	67, 400	
TOTAL CHARGES	2, 315, 230	
CONTINGENCIES		
ESCALATION		
GRAND TOTAL	2, 315, 230	

REMARKS Accuracy of Estimate ± 10%

4.C - Summary of Capital Costs

ESTIMATE NO. 2432
DATE March 15, 1984
PAGE 4 OF 4

S U B - S U M M A R Y

CUSTOMER SUPPLIES AND SERVICES CANADA
LOCATION

CODE	DESCRIPTION	MATERIAL	LABOR	SUBCONTRACT
0100	FIRED HEATERS & BOILERS			
0200	STACKS			
0400	REACTORS & INTERNALS			
0500	TOWERS & INTERNALS			
0600	HEAT EXCHANGE EQUIPMENT	354,100	-0-	9,300
0700	COOLING TOWERS			
0800	VESSELS, TANKS, DRUMS & INTERNALS	16,400	-0-	2,400
0900	PUMPS & DRIVERS	9,200	-0-	1,000
1000	BLOWERS & COMPRESSORS			
1100	ELEVATORS, CONV., MTLS.,HANDG. EQUIP.			
1200	MISC. MECHANICAL EQUIPMENT			
2500	TANKAGE			
2800	FILTERS AND CENTRIFUGES			
2900	AGITATORS AND MIXERS			
3000	SCRUBBERS AND SEPARATORS			
3100	MACHINE TOOLS & MACH. SHOP EQUIP.			
3200	HEATING, VENTILATION, AIR COND., DUST CONT.			
3400	PACKAGE UNITS	1,110,000		16,500
	SUB-TOTAL - MAJOR EQUIPMENT	1,489,700		29,200
1300	PIPING	56,100	-0-	84,360
1400	SEWERS			
1500	INSTRUMENTATION	21,700	-0-	12,000
1600	ELECTRICAL	45,950	-0-	48,800
1700	CONCRETE	-0-	-0-	11,800
1800	STRUCTURAL STEEL	-0-	-0-	100,500
1900	FIREPROOFING	-0-	-0-	60,700
2000	BUILDINGS	3,000	-0-	2,000
2100	SITE DEVELOPMENT			
2200	INSULATION			23,400
2300	PAINTING & PROTECTIVE COATINGS			5,900
2400	FIELD TESTING			5000
2600	CHEMICALS AND CATALYST			
2700	PILING			
3300	FIRE PROTECTION			
3500	MISC. FURNITURE FOR PLANT BLDGS.			
	SUB-TOTAL	1,616,450	-0-	383,660
3700	MISC. DIRECT CHARGES	8,800	-0-	-0-
3800	STOREHOUSE ACCOUNTS			
3900	CONSTRUCTION SUPPLIES AND PETTY TOOLS			
5000	INSURANCE AND TAXES	7,400		
6000	SUPERVISION AND FIELD OFFICE		60,300	
6500	CONSTRUCTION EQUIPMENT & TOOLS	30,000		
7000	HOME OFFICE EXPENSES	5,600	135,620	
	TOTAL DIRECT COSTS	1,668,250	195,920	383,660

4. COMPLETE DESCRIPTION OF WORK UNDERTAKEN (continued)

d) Savings And Return On Capital

The process flow diagram produced by Coors shows 13,300 LBS/HR of steam produced by the heat pump. This figure neglects the following:

a) Boiler feed water temperature.
b) Boiler blowdown.
c) Process upsets or shutdown.
d) Heat losses.

Coors will guarantee only 85% of this flow = 11,300 LBS/HR of steam.

This figure compares well with Energy Concepts process flow diagram which gives 47.7% recovery on 25.2 MM BTU/HR of waste heat = 12.02 MM BTU/HR duty on the absorber. This is equivalent to 11,760 LBS/HR of 190 PSIG steam if the boiler feed water is 200°F.

Sunoco has insufficient steam raising capacity for their requirements and some 450 psig steam is purchased from Dow Chemical Canada. Dow use natural gas and residual fuel oil to generate this steam, which would be the steam replaced by that generated by the heat pump. The cost of the 450 psig steam is $7.50 per 1000 lbs. and pro-rating on heat content, the 185 psig steam is worth $6.91 per 1000 lbs.

Steam Saving = 360 Days x 24 Hrs. x 11,300 LBS/HR x $6.91/1000 LBS
= $675,000 Per Year.

4. COMPLETE DESCRIPTION OF WORK UNDERTAKEN

d) Savings And Return On Capital (continued)

Electrical Cost

The heat pump will require some electricity to run:-

Air Cooler AC-1	50% x 240 HP	= 120 HP
Pump P-1		= 25 HP
Pump P-2		= 20 HP
Pump P-3		= 5 HP
TOTAL		= 170 HP

There will be a saving on the existing air cooler of 50% x 160 HP = 80 HP Net increase in HP = 90 HP

90 HP installed 70 HP usage.

Electrical Cost = 70 HP x 0.746 x 24 Hrs. x 360 Days x $0.028 KWH
= $13,000 Per Year.

Net savings on heat pump = $675,000 - $13,000 = $662,000

Payback Period

The simple payable period is $2,310,000 ÷ $662,000 = 3.5 Years

Sunoco are looking for a payback period of less than 2 years or a return on investment of over 60% on an energy conservation project, at this time.

4. COMPLETE DESCRIPTION OF WORK UNDERTAKEN

d) Savings And Return On Capital (continued)

Working Life of Chemical Heat Pump

The chemical heat pump consists mainly of heat exchangers and pumps. The pumps should have a working life of around 10 years and the heat exchangers should have a working life of about 20 years, providing the correct materials of construction are used.

e) Reporting On Performance Of The Heat Pump

In the event of a heat pump being installed at Sunoco, discussions with Sunoco as to the best method of reporting performance with the least inconvenience would be required. Discussions with Coors would also be required. For example, corrosion probes could be installed in the ITB so corrosion could be monitored without shutting down the equipment.

The main aim would be to report the amount of steam produced by the ITB. A flow recorder in the control room for the steam produced has been included for this purpose. Some of the operating conditions on the process side would have to be recorded so that any process upsets could be detected. Any deviation from the expected flow of steam would require an explanation. This point will require much thought as to the best way to achieve this objective. Full instrumentation of the heat pump would be the best solution, but would be expensive. Only the basic instrumentation has been costed in this study. Another possible solution would be an alarm on the flow of steam and somebody in the field checking the ITB to find what the problem is.

Routine maintenance, and any problems with the ITB, would have to be reported. This could be by Sunoco or SCL. The home office manhour estimate has included 1 day per month for 2 years for routine collection of operating data from the field.

5. TECHNICAL DISCUSSION

a) 'What If' Analysis

The specific heat pump installation could have been installed and operated in alternative ways and this section looks at the cost impact of some of these alternatives.

Using Cooling Water Instead of Air Cooling

If Sunoco had surplus cooling water to supply at no cost, then the equipment cost would be reduced. The air cooler cost was $247,000 and if this was replaced by a shell and tube water cooler, its cost would probably be under $100,000. The installed cost would be reduced by about $250,000, which would reduce the payback period from 3.5 Years to 3.1 Years.

Producing 140 PSIG Steam

If Sunoco's medium pressure steam header operated at 140 PSIG and the ITB produced this pressure steam, then the heat transfer area of the ITB would be reduced by 18%. This would reduce its cost about $200,000 and reduce the installed cost about $300,000. The payback period would reduce from 3.5 Years to 3.0 Years.

Waste Heat Used on the Tower Reboiler

If the heat output from the ITB was put into the bottom of the toluene tower by passing the hot LiBr through a new reboiler, Coors estimate a cost reduction of $100-$120,000 on the ITB. This would include the new reboiler. The reduction in cost is because of the lower output temperature and the reduced heat transfer area. This saving would be reduced by the cost of a royalty to Energy Concepts, who have a patent on this type of application. There would probably be an overall saving in the order of $80-$100,000 on the capital cost. The heat saving would be the same.

5. TECHNICAL DISCUSSION (continued)

b) Limits Of Feasibility Of Chemical Heat Pump

400°F is probably the highest temperature a LiBr heat pump can operate at present, though it could operate higher with the proper materials of construction. This temperature, corrosion and materials of construction are discussed in Section 5 c).

Any source of waste heat can be used to drive the heat pump but the maximum economic temperature boost is about 120°F, so the waste heat temperature should not be over 120°F below the required useful heat output temperature. The heat pump can provide a temperature boost of about 90% of the difference between the waste heat and the low temperature heat sink. Therefore, it is unlikely that the waste heat source would be less than 180°F. With a 180°F heat source and cooling at 80°F, then the heat output would be 0.9 x (180-80) + 180 = 270°F.

The amount of waste heat required to drive a heat pump is governed by the economics, but it is unlikely that less than 10 MM BTU/HR would give an economic installation. It is possible to recover about 45-50% of this waste heat.

The feasibility of a specific heat pump application would depend on the economics of that application, as well as practical consideration of space, use of the recovered heat, etc.

5. TECHNICAL DISCUSSION (continued)

c) Areas Of Concern

Development work is taking place on chemical heat pumps using sulphuric acid, but at present lithium bromide systems are the closest to being a proven technology. LiBr cycles have traditionally used Cu-Ni construction up to about 260°F and stainless steel up to about 330°F. Battelle Memorial Institute have conducted corrosion tests at higher temperatures on various materials of construction and Coors claim output temperatures up to 400°F. Obviously a client purchasing a heat pump operating above 330°F would want to verify that a suitable material of construction is being used, and in the case of cladding, that a suitable method of construction is being used.

The other area of concern is the removal of air from the equipment. Because the heat pump works under vacuum, small amounts of air will be drawn in. Coors include in their package a system for continually purging the internals of noncondensable gases. The reliability of this system would have to be checked, as it is essential to the working of the heat pump. An air leak will result in a drop in steam production from the heat pump. The presence of air and LiBr will result in corrosion so the heat pump should be shut down and the leak repaired.

5. TECHNICAL DISCUSSION (continued)

d) Energy Conservation Benefits Of Heat Pumps For This Specific Application

Adolph Coors Company have been surveying companies for possible absorption heat pump applications for a year, and their figures are the best available without an extensive market survey. They state that there are between 1 and 4 possible applications on distillation towers in a petroleum or petrochemical plant. The average would be 2 to 3 applications, with 10 to 20 MM BTU/HR of waste heat. About 25% of these would be good applications, meaning the waste heat would be over 10 MM BTU/HR and the temperature would be reasonably high. This figure would be reduced to 10% by practical considerations such as space available, temperature boost required and economics.

The total number of Canadian refineries and petrochemical plants is 101. (Petrochemical Plants = 70 ref. Oil Week February 13, 1984, page 8.) (Canadian refineries = 31 ref. Canadian Petroleum September 1983.)

Using 45% of waste heat recovered, then the previous figures can be interpreted as follows:

Maximum potential heat recovery on distillation units in Canadian refinery and petrochemical plant = 2.5 applications x 15 MM BTU/HR x 45% x 101 plants = 1700 MM BTU/HR

A realistic upper figure for heat recovery would be 25% of this, or 425 MM BTU/HR, while a realistic practical figure would be 10% of this, or 170 MM BTU/HR. These realistic figures are based on an expected payback period of between 1 and 3 years, but the actual payback period could drastically affect these estimates. Very few installations would go ahead with a payback of 4 years, while a 1 year payback would be considered good by industry.

5. TECHNICAL DISCUSSION

d) Energy Conservation Benefits Of Heat Pumps For This Specific Application (continued)

These figures take no account of the competitive effect of other heat recovery methods; i.e. vapour recompression, heat transfer of waste heat to process fluid. One of these methods may prove more cost effective than a chemical heat pump.

6. CONCLUSION

a) The payback period for this heat pump application was 3.5 Years. This could be reduced to about 3.0 Years on a similar but ideal application.

b) The payback period of a new heat pump application, as opposed to a retrofit, would probably show better payback periods.

c) It is unlikely that industry would find the type of heat pump in this study attractive without subsidy or financial incentive at the present fuel prices.

d) The LiBr heat pump has many advantages and has good potential for energy conservation. Its advantages include (a) very little power is required, (b) low operating costs, (c) good mechanical reliability, as there are no moving parts other than the pumps, (d) little technical sophistication in the equipment as it mainly consists of heat exchangers, and (e) excellent turndown on reduced load. Its use should be encouraged in industry either by purchase as a proprietary item or designed and developed as a non proprietary item. The latter method would probably be cheaper in the long run, but would involve 1 or 2 years delay with the development and testing.

EXHIBIT A

STEARNS CATALYTIC

CHEMICAL HEAT PUMP FEASIBILITY STUDY

PROJECT #2432

MARCH 15, 1984

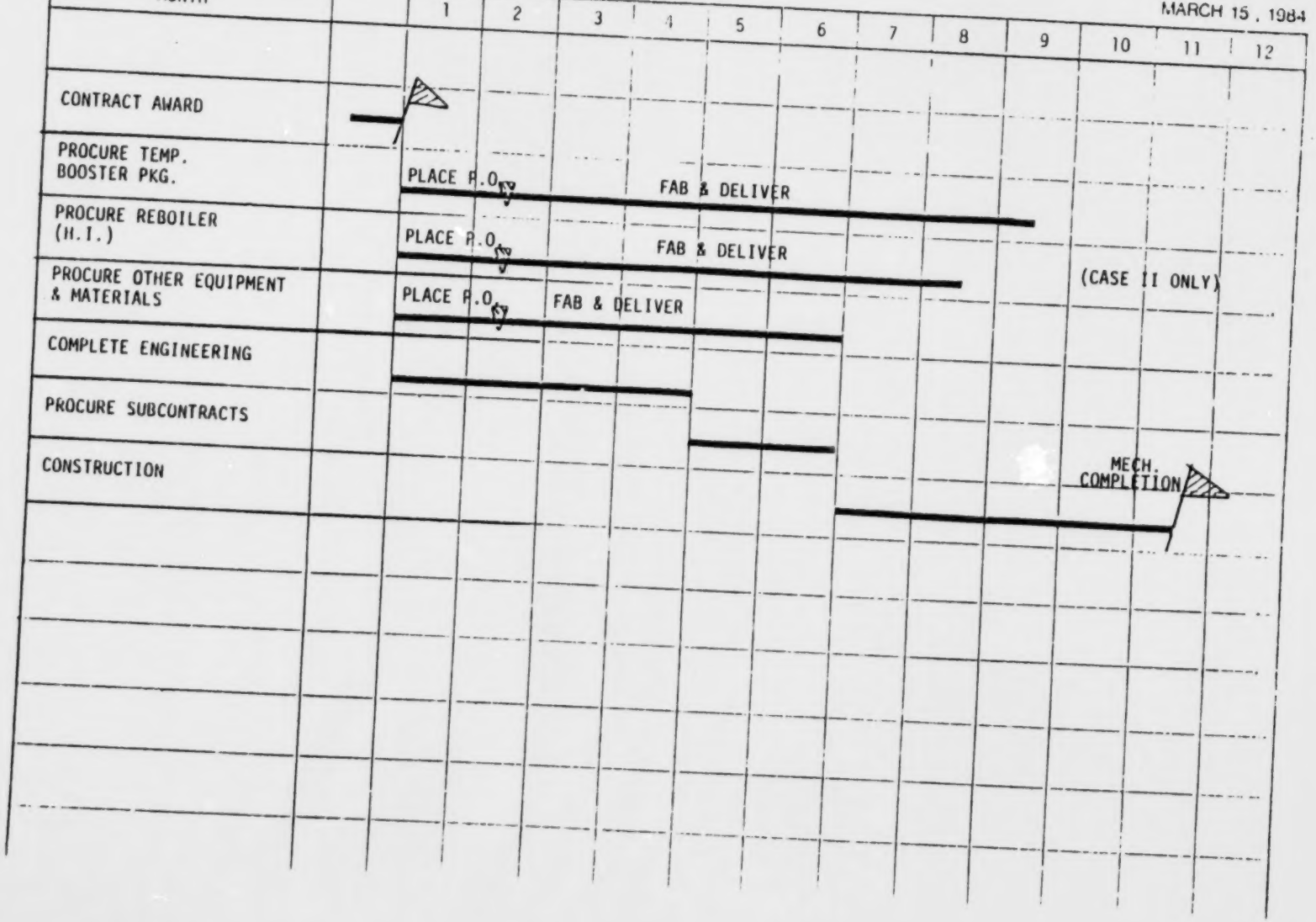


EXHIBIT B

Sunoco Group

1984 March 21

Engineering Department
Stearns Catalytic
P. O. Box 3008
Sarnia, Ontario. N7T 7M7

ATTENTION: Mr. Peter Davies

Dear Peter:

We are interested in the possibility of installing absorption heat pumps to recover low temperature heat in our refinery. One promising area of application for this technology is our fin-fan condensers. These condensers reject more than 20% of our total energy flow in the refinery to atmosphere. The best condensers to consider at first are those that handle more than 30 million Btu/hr. at relatively high temperature. In order to avoid startup and heat balance problems, the heat pump should generate steam rather than supply process heat directly. Our toluene tower fin-fan condenser would be a good case for an initial study. This condenser has a heat load of 34 million Btu/hr. and a process inlet temperature of 245°F. Further details are available at the refinery.

If the government study you are proposing to carry out indicates that we can expect to obtain a simple payback of less than two years for a heat pump of this sort, I will submit this as an item in our 1985 budget for approval by refinery management.

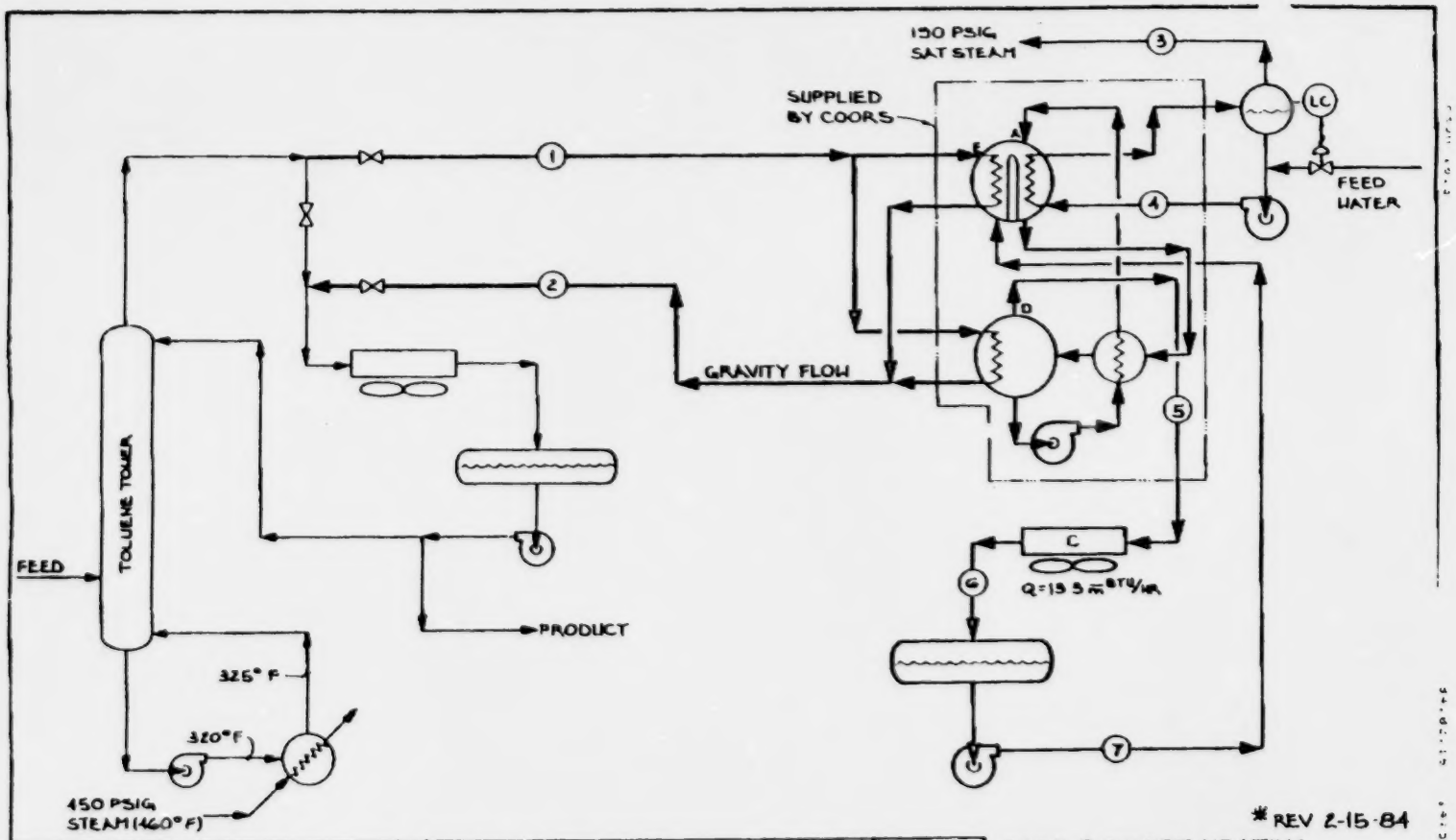
Yours truly,

D. Bayly
Energy Conservation Coordinator
SUNOCO INC.

DJB/jmcn

P.O. Box 307, Sarnia, Ontario N7T 7J3 Telephone (519) 337-2301

EXHIBIT C



* REV 2-15-84

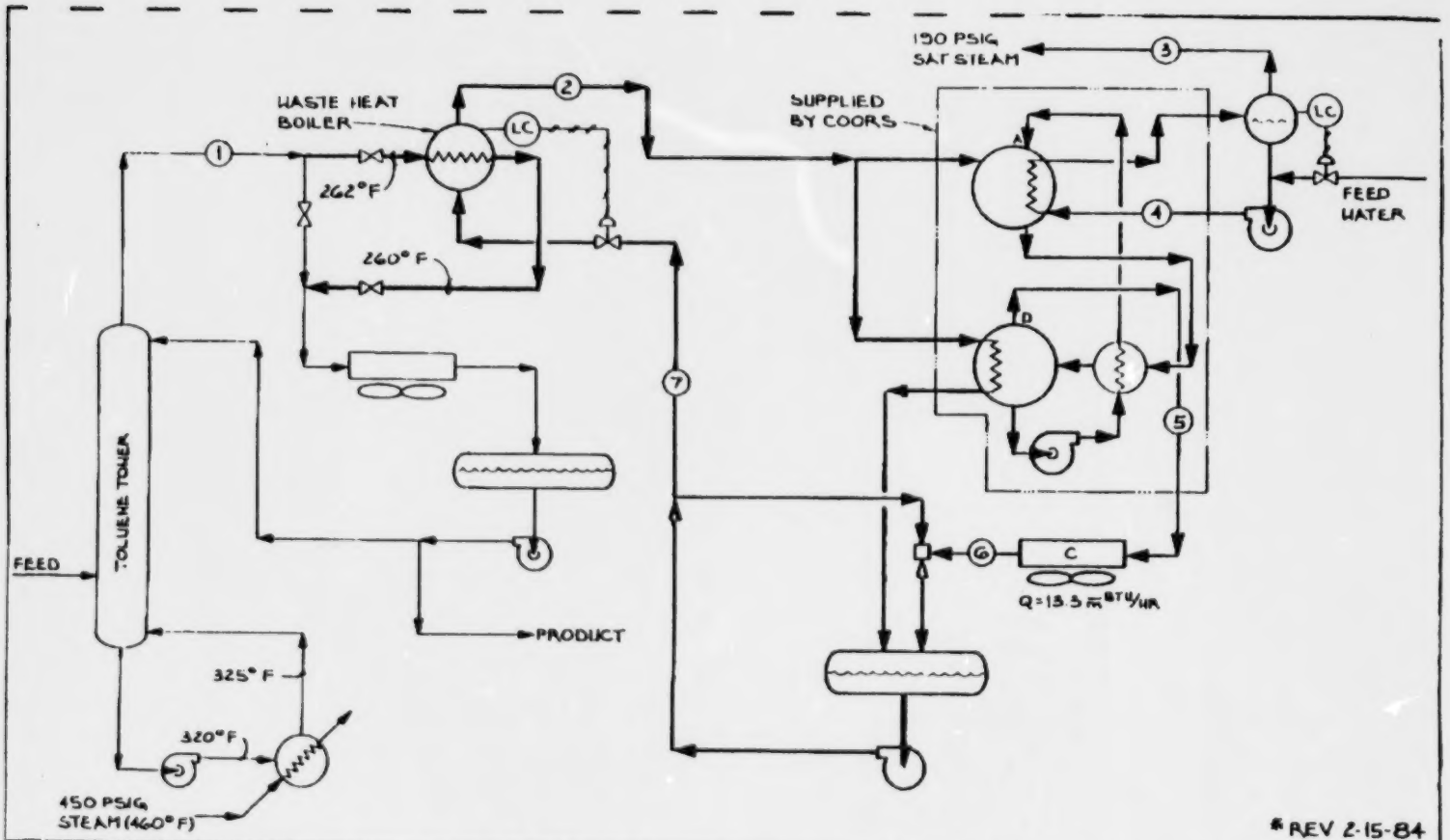
LINE NO.	1	2	3	4	5	6	7
MATERIAL	TOLUENE VAPOR	TOLUENE LIQUID	STEAM	WATER	STEAM	WATER	WATER
QUANTITY	166,000#/HR	166,000#/HR	13,300#/HR	* ~427700#/HR	12200#/HR	244 GPM(US)	564 GPM(US)
PRESSURE	6 PSIG	———	190 PSIG	-200 PSIG	13 PSIA	1.0 PSIA	-35 PSIG
TEMPERATURE	262° F	260° F	384° F	377° F	240° F	110° F	110° F

CASE I-DIRECT HEATING

ADOLPH COORS COMPANY

ITB APPLICATION
FOR SUNOCO, SARNIA ONT

APPD BY [signature] DATE 2-14-84



LINE NO.	1	2	3	4	5	6	7
MATERIAL	TOLUENE VAPOR	STEAM	STEAM	WATER	STEAM	WATER	WATER
QUANTITY	166,000#/HR	26,600#/HR	13,300#/HR	*~427,700#/HR	12,200#/HR	24.4 GPM(US)	56.1 GPM(US)
PRESSURE	6 PSIG	30 PSIA	150 PSIG	~200 PSIG	1.3 PSIA	1.0 PSIA	~50 PSIG
TEMPERATURE	262° F	250° F	384° F	377° F	240° F	110° F	*~200° F

CASE II-WASTE HEAT BOILER

ADOLPH COORS COMPANY

ITB APPLICATION
FOR SUNOCO, SARNIA ONT

APVD [illegible] DATE [illegible]

ENERGY CONCEPTS CO.
627 Ridgely Ave. Annapolis, Md. 21401 • 301/266-6521

February 29, 1984

To: Mr. Peter Davis
Stearns Catalytic Ltd.
P.O. Box 3008
Sarnia, Ontario N7T 7M7

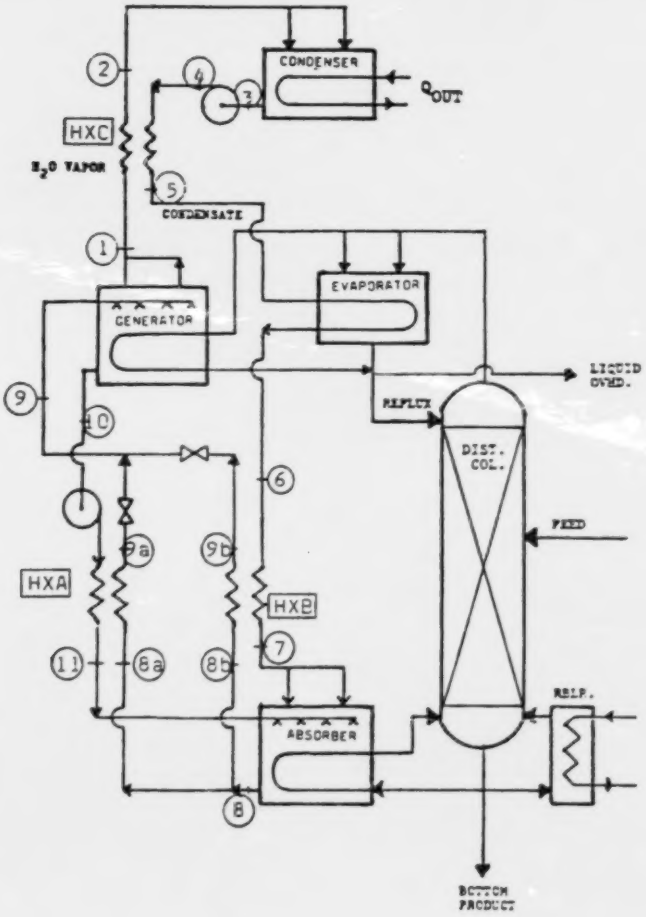
I N V O I C E

Case 1	$ 150
Case 2	$ 150
TOTAL	$ 300

William F. Davidson

WRAP-AROUND ABSORPTION CYCLE

RAHP



ENERGY CONCEPTS CO.
627 Ridgely Ave. Annapolis, Md. 21401 • 301/266-6521

COST BENEFIT ANALYSIS FOR WRAP-AROUND ABSORPTION CYCLE - CASE 1

APPLICATION: TOLUENE COLUMN

CYCLE TYPE: REVERSE

REBOIL TEMP. = 385 F
REFLUX TEMP. = 262 F
AMBIENT TEMP.= 85 F (95F avg. cooling Temp)
REBOILER DUTY = 25.20 MMBTU/hr
REFLUX CON. DUTY= 25.20 MMBTU/hr

OPERATING PARAMETERS

STREAM NO.	FLUID DESCRIPTION	TEMP. (F)	PRES. (PSIA)	CONC. (W/O LiBr)	ENTHALPY (BTU/LB)	FLOW (1000 LB/HR)
1	STM.FROM GEN	245.3	1.12	0.0	1170.7	12.01
2	STM.FROM GEN	245.3	1.12	0.0	1170.7	12.01
3	WTR.FROM COND.	105.5	1.12	0.0	73.6	12.01
4	WTR.FROM PUMP	105.5		0.0	73.6	12.01
5	WTR.FROM PUMP	105.5		0.0	73.6	12.01
6	STM.FROM EVAP.	246.9	28.25	0.0	1162.9	12.01
7	STM.FROM EVAP.	246.9	28.25	0.0	1162.9	12.01
8	SOL.FROM ABS	404.7	28.25	68.5	195.5	217.6
8a	SOL.FROM ABS	404.7	28.25	68.5	195.5	217.6
8b	----N.A.--------					
9a	SOL'N. TO GEN.	269.4		68.5	140.1	217.6
9b	----N.A.--------					
9	SOL'N. TO GEN.	269.4		68.5	140.1	217.6
10	SOL.FROM GEN	245.3	1.12	72.5	138.9	205.6
	SOL.TO ABS.	394.7		72.5	197.5	205.6

Reboiler energy savings = 47.7 percent.

MAJOR COMPONENT	DUTY (MMBTU/HR)	LMTD (F)
ABSORBER	12.02	19.7
GENERATOR	12.12	16.7
EVAPORATOR	13.08	15.1
CONDENSER	13.18	10.6
EXCHANGER A	12.04	16.0

SOL'N. PUMP (436.5 gpm, 5.87 KW, sealess)

COST BENEFIT ANALYSIS FOR WRAP-AROUND ABSORPTION CYCLE case 2

APPLICATION: TOLUENE COLUMN

CYCLE TYPE: REVERSE

REBOIL TEMP. = 361 F
REFLUX TEMP. = 262 F
AMBIENT TEMP.= 85 F (95 F amb wet bulb temp
REBOILER DUTY = 25.20 MMBTU/hr
REFLUX CON. DUTY= 25.20 MMBTU/hr

OPERATING PARAMETERS

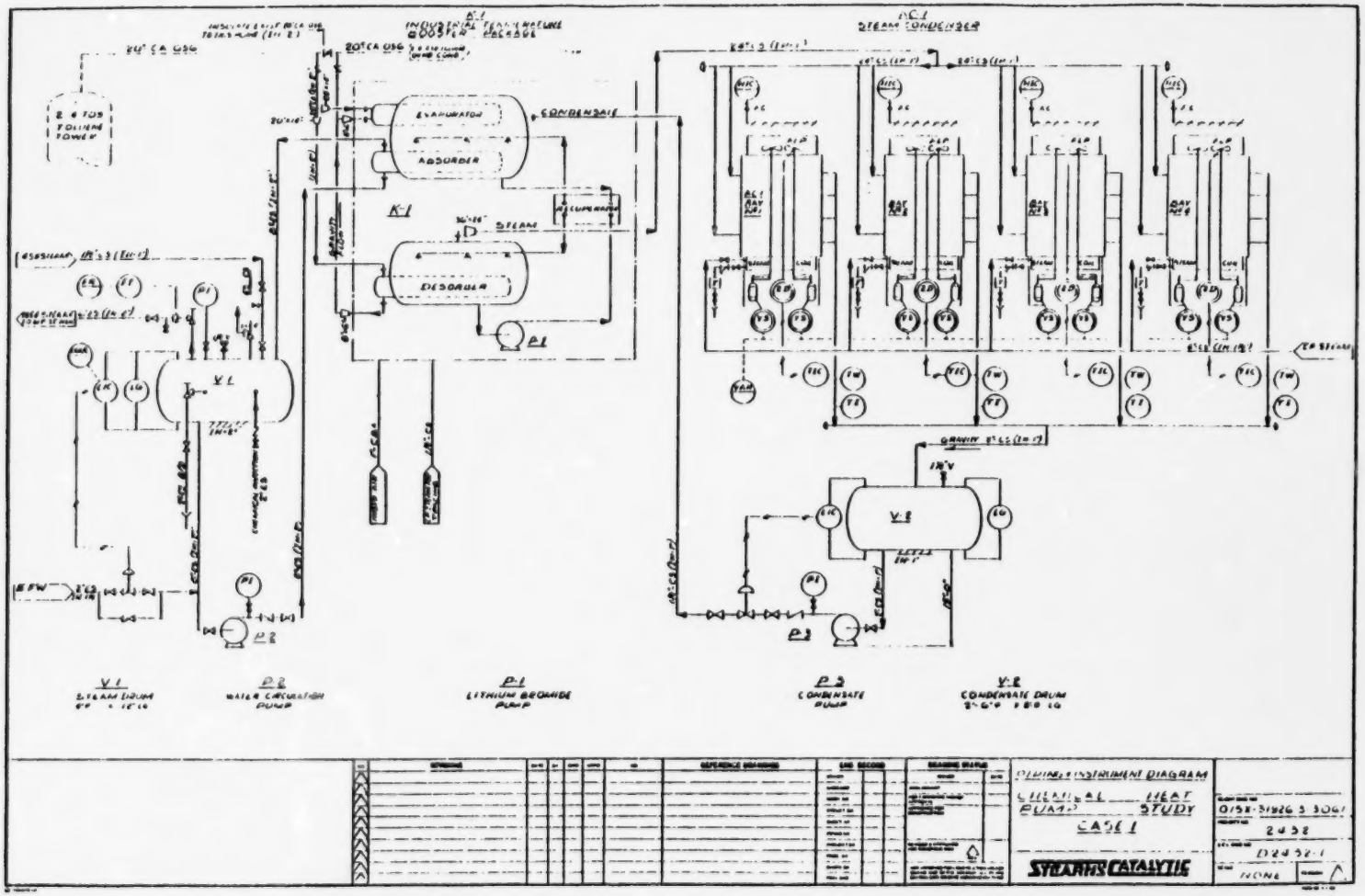
STREAM NO.	FLUID DESCRIPTION	TEMP (F)	PRES. (PSIA)	CONC. (W/O LiBr)	ENTHALPY (BTU/LB)	FLOW (1000 LB/HR)
1	STM.FROM GEN	240.5	1.23	0.0	1168.5	12.02
2	STM.FROM GEN	240.5	1.23	0.0	1168.5	12.02
3	WTR.FROM COND.	108.7	1.23	0.0	76.8	12.02
4	WTR.FROM PUMP	108.7		0.0	76.8	12.02
5	WTR.FROM PUMP	108.7		0.0	76.8	12.02
6	STM.FROM EVAP.	242.5	26.12	0.0	1161.3	12.02
7	STM.FROM EVAP.	242.5	26.12	0.0	1161.3	12.02
8	SOL.FROM ABS	386.6	26.12	66.7	185.8	212.6
8a	SOL.FROM ABS	386.6	26.12	66.7	185.8	212.6
8b	----N.A.-------					
8a	SOL'N. TO GEN.	264.3		66.7	134.6	212.6
8b	----N.A.-------					
9	SOL'N. TO GEN.	264.3		66.7	134.6	212.6
10	SOL.FROM GEN	240.5	1.23	70.7	133.3	200.5
11	SOL.TO ABS.	376.6		70.7	187.5	200.5

Reboiler energy savings = 47.9 percent.

MAJOR COMPONENT	DUTY (MMBTU/HR)	LMTD (F)
ABSORBER	12.08	25.4
GENERATOR	12.16	21.5
EVAPORATOR	13.04	19.5
CONDENSER	13.12	13.7
EXCHANGER A	10.66	15.9

SOL'N. PUMP (425.8 gpm, 5.26 KW, sealess)

EXHIBIT D


K-1
EVAPORATOR
ABSORBER
DESORBER
CONDENSATE
STEAM
P1
V-1
V-2
P2
P3
STEAM CONDENSER
PLUMBING & INSTRUMENT DIAGRAM
CHEMICAL HEAT PUMP STUDY
CASE I
STREAMS CATALYTIC
NONE

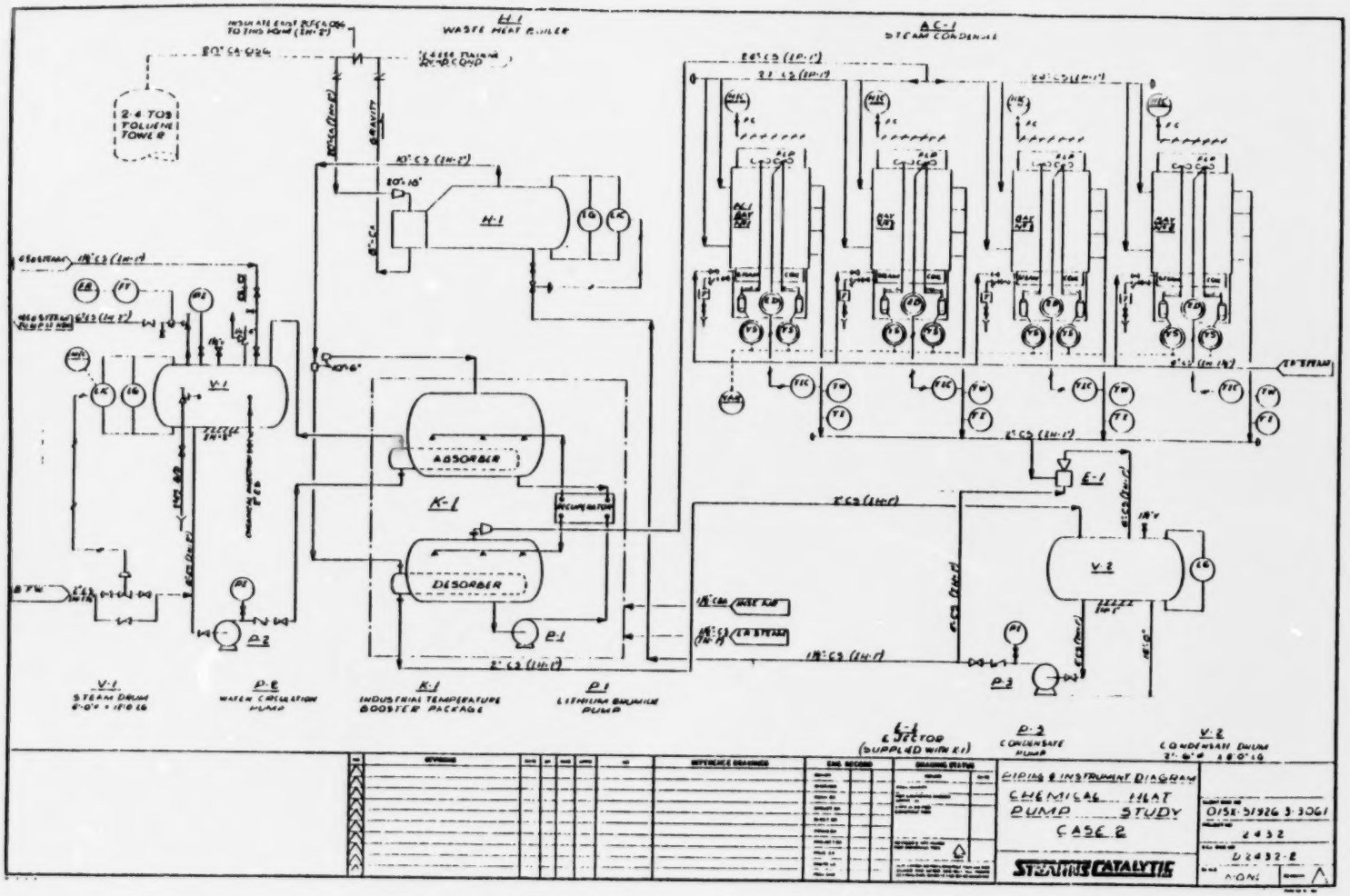
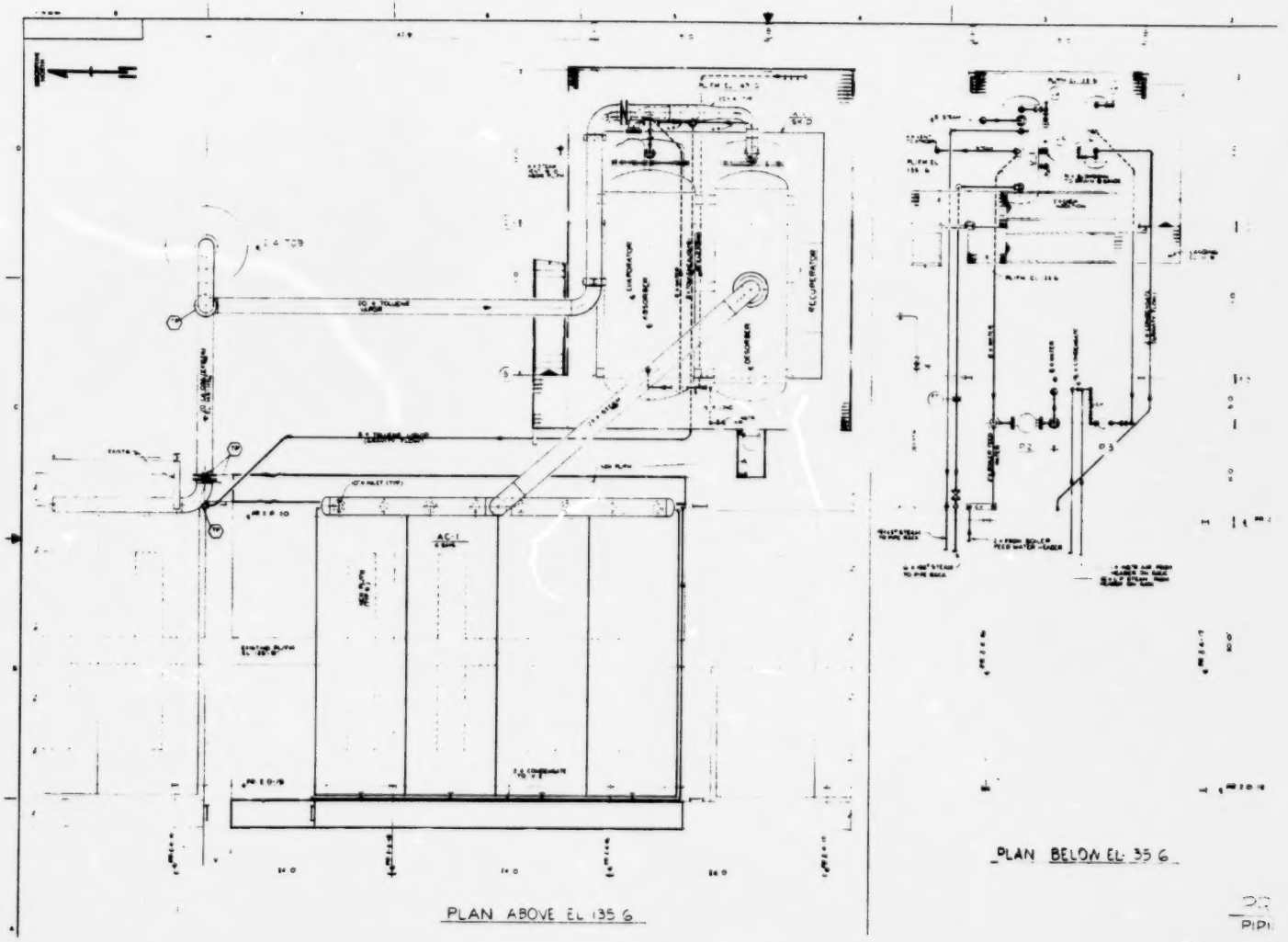
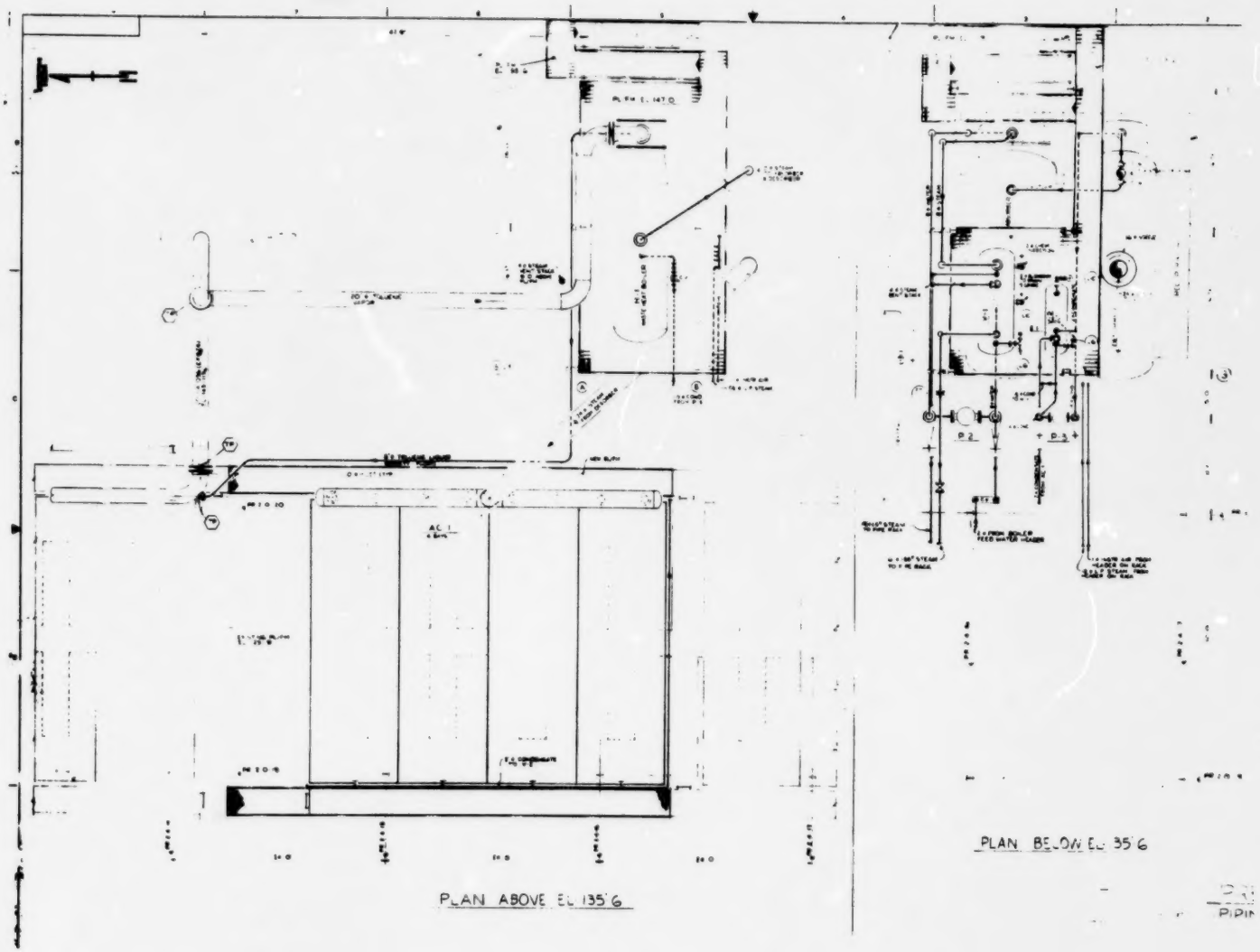

H-1
WASTE HEAT BOILER
AC-1
STEAM CONDENSER
2-4 TDI TOLUENE TOWER
ABSORBER
DESORBER
K-1
V-1
P-1
P-2
E-1
V-2
V-1 STEAM DRUM
P-2 WATER CIRCULATION PUMP
K-1 INDUSTRIAL TEMPERATURE BOOSTER PACKAGE
P-1 LITHIUM BROMIDE PUMP
E-1 ECONOMISER (SUPPLIED WITH K-1)
P-3 CONDENSATE PUMP
V-2 CONDENSATE DRUM
PIPING & INSTRUMENT DIAGRAM
CHEMICAL HEAT PUMP STUDY
CASE 2
STEARNS CATALYTIC
D2432-2

EXHIBIT E



Preliminary Piping Study - Case I. Client drawing No. 015X-31926-3-3061.
Drawing No. E2432-3. Prepared by Stearns Catalytic Ltd.



Preliminary Piping Study - Case II. Client drawing No. 015X-31926-3-3061. Drawing No. E2432-4. Prepared by Stearns Catalytic Ltd.

EXHIBIT F

February 27, 1984

Mr. David Bayly
Energy Conservation Coordinator
Sunoco, Inc.
Sarnia, Ontario, N7T 7J3
CANADA

Dear Mr. Bayly:

The Adolph Coors Company is pleased to present our proposal to furnish Sunoco an Industrial Temperature Booster for a steam producing application at your Sarnia, Ontario, refinery.

Our proposal is based on information supplied by Peter Davies of Stearns-Catalytic.

Sunoco can rest assured that the soundest engineering design, fully industrial-rated components and the highest quality of fabrication will be incorporated in this ITB. The Adolph Coors Company has, for many decades, placed the utmost importance on producing products of the highest possible quality and maintaining relationships with our customers that are second to none.

We are appreciative of this opportunity to present a proposal for an ITB and are eager to establish a working relationship with the Sunoco organization.

Should you have any questions and/or require additional information or clarification, please call me at (303) 277-2113, or Mike Lane at (303) 277-2388.

We look forward to your response.

Sincerely,

Lowell T. Whitney, P.E.
Manager, Technical Sales

LTW/rs:3-473

Enclosure

CONTENTS

SECTION 1 - INTRODUCTION

The Industrial Temperature Booster

Battelle Memorial Institute

Adolph Coors Company

SECTION 2 - SPECIFICATIONS

Performance/Physical Specs

Process Flow Diagram

Plan and Elevation Drawings

SECTION 3 - STATEMENT OF WORK

Items by Coors

Items by Others

SECTION 4 - TERMS AND CONDITIONS OF SALE

Agreement

Appendix A

Appendix B

SECTION 5 - QUOTATION

Price/Delivery

SECTION 6 - ATTACHMENTS

Rate Schedule for Additional Services

Coors 1982 Annual Report

Coors Fabrication Shop Brochure

LWhitney/bar:4028A.7
02/24/84

THE INDUSTRIAL TEMPERATURE BOOSTER

INTRODUCTION:

The Industrial Temperature Booster (ITB) is a waste-heat-powered heat pump for industrial applications. It uses a chemical absorption cycle to upgrade waste heat to useful levels, operating on inputs in the range of 180°F to 350°F with outputs of 250°F to 400°F. Normally, the output would be process steam. The ITB has a thermal efficiency of about 45%. Since the input is nearly all waste heat, which is currently rejected, the ITB allows the recovery of 45% of that heat. The cost of installing an ITB unit is justified by a reduction in fuel costs.

HISTORY:

The development of the ITB (formerly known as the Battelle Temperature Booster) began with an invention by a staff member of the Battelle Memorial Institute of Columbus, Ohio, in March 1976. Based upon this work, Battelle conducted a market survey in mid-1976.

The market study confirmed that industrial applications were technically realistic, and it showed that potential users were seriously interested in system development and demonstration.

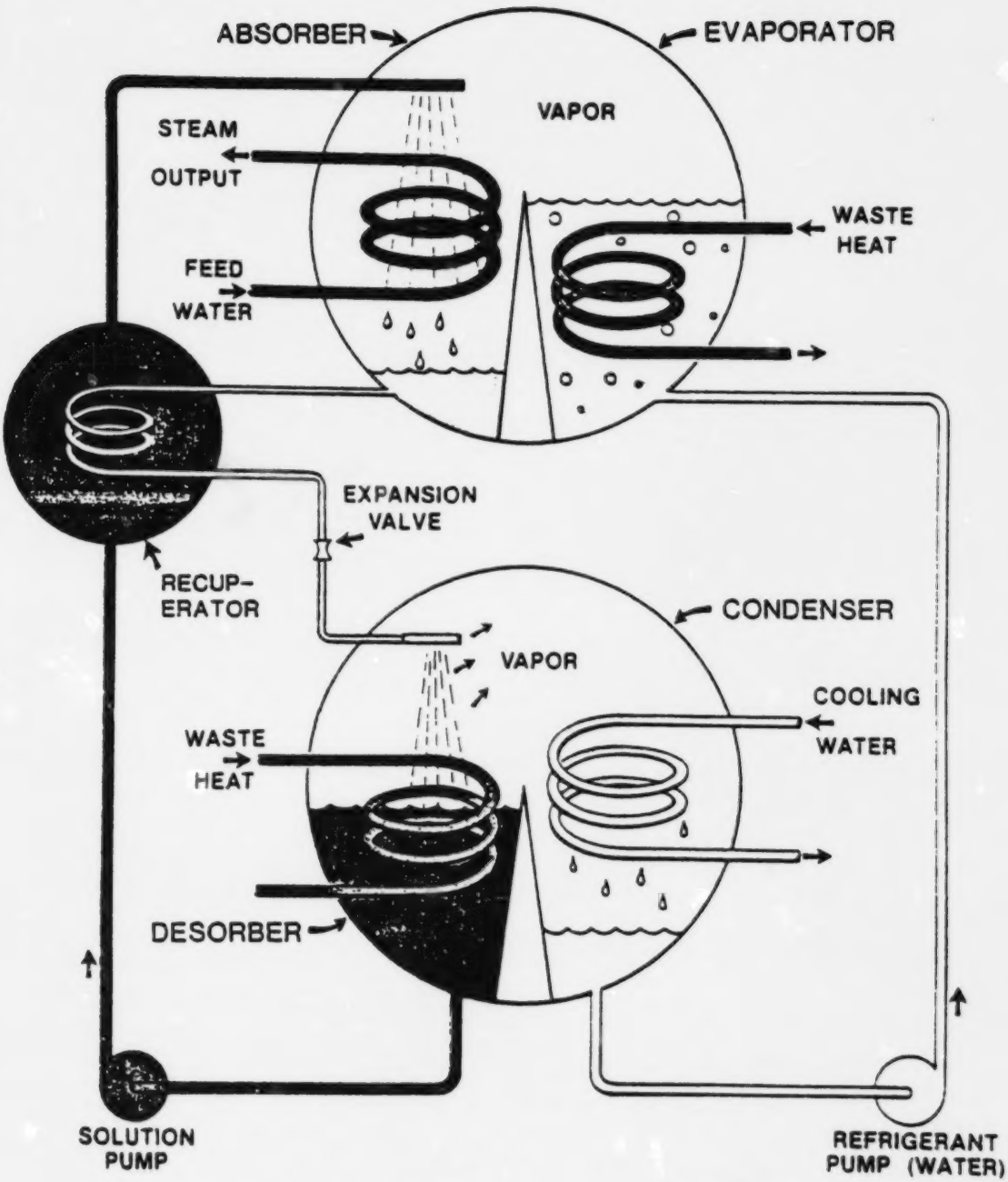
In early 1978, a 180-ton absorption chiller was converted to use as the basis for a 2-million BTU/hour demonstration machine. This program was successfully completed in late 1978.

An active effort to license the technology was begun in early 1980. It was through this effort to license the technology and respond to potential users that contact was first made with Adolph Coors Company in late 1981. In 1983, Coors was licensed by Battelle to design, fabricate and market these devices.

OPERATION:

An ITB is a chemical absorption heat pump consisting of heat exchangers, circulation pumps, and lithium bromide and water as working fluids. The temperature gradient between the waste heat source and the low temperature sink is used to power the "engine" portion of the ITB, which drives the "heat pump" portion.

The illustration on the following page shows two pressure vessels with two heat exchangers each. The right side of the machine -- evaporator and condenser heat exchangers and the refrigerant pump -- make up the engine portion of the machine. The left side -- absorber, desorber, solution pump and recuperator -- comprises the solution heat pump.


ABSORBER
EVAPORATOR
VAPOR
STEAM
OUTPUT
FEED
WATER
WASTE
HEAT
EXPANSION
VALVE
RECUP-
ERATOR
CONDENSER
VAPOR
COOLING
WATER
WASTE
HEAT
DESORBER
SOLUTION
PUMP
REFRIGERANT
PUMP (WATER)
"HEAT PUMP" SIDE
"ENGINE" SIDE

Waste heat is fed into the evaporator heat exchanger where it vaporizes water in the vessel. The vapor flows to the absorber side of the vessel where concentrated lithium bromide solution is being sprayed on the heat exchanger. The solution is hydroscopic and absorbs the water vapor into solution, giving off the heat of absorption which is about 1,000 BTU's per pound of vapor. This heat is given off at a higher temperature than the waste heat input and provides useful heat on the output side of the absorber heat exchanger.

The dilute solution then flows through a recuperator and an expansion valve to the lower vessel. The pressure is low enough in this vessel that the same waste heat source used in the evaporator can boil the water out of solution through the desorber heat exchanger. The reconcentrated solution is then pumped back to the absorber.

The vapor boiled out of the solution flows to the condenser heat exchanger, which is cold enough to condense the vapor. The refrigerant is then pumped back to the evaporator to complete the cycle.

BATTELLE MEMORIAL INSTITUTE

Battelle Memorial Institute has as its broad objective the benefit of mankind by the advancement and utilization of science through technological innovation and educational activities. The Institute, which began operations in 1929, was established in Columbus, Ohio, by the will of Gordon Battelle and serves as a memorial to his family -- leaders in Ohio's early steel industry. A pioneer in contract research, the Institute has major research centers in Columbus, Ohio; Frankfurt, West Germany; Geneva, Switzerland; and Richland, Washington; and other specialized facilities, offices and representatives in many other locations throughout the world. It is a "not for profit" organization and has no manufacturing or marketing capabilities.

The Columbus Lab, which is where the BTB technology was developed, employs about 3,000 people and conducts $70 million worth of research per year.

ADOLPH COORS COMPANY

The Adolph Coors Company started business in 1873 brewing beer. Beer remains the Company's main product accounting for approximately 85% of sales. Coors had sales in 1982 in excess of $1 billion. Over the years, Coors has focused on attaining a high degree of vertical integration. This, coupled with the Company's philosophy of avoiding long-term debt, had made Coors one of the most financially sound companies in the U.S.

The vertical integration has resulted in the formation of a number of subsidiaries, such as Coors Porcelain, Coors Food Products, Coors Transportation, Coors Packaging, Golden Recycle and Coors Energy Company.

In addition, Coors has a substantial fabrication facility (see appendix) which has marketed its services outside of Coors for about five years. Coors also has developed and/or purchased a number of technologies which it has marketed. The ITB was acquired due to its fit with our steam and power generation expertise and increased utilization of our fabrication facilities.

Coors

SUNOCO - INDUSTRIAL TEMPERATURE BOOSTER

CASE I - SPECIFICATIONS FOR DESIGN CONDITIONS

Input: 166,000 lb/hour of 262°F Toluene Vapor (6psig)

Output: 413,645 lb/hour saturated and 13,300 lb/hour saturated steam at 190 psig and 384°F to steam drum *

12,200 lb/hour 1.3psia 240°F super heated steam to air cooled condenser

Utility Requirements: 80psig Instrument Air

Electrical Power

25 Horsepower - Solution Pump

Size: Approximately

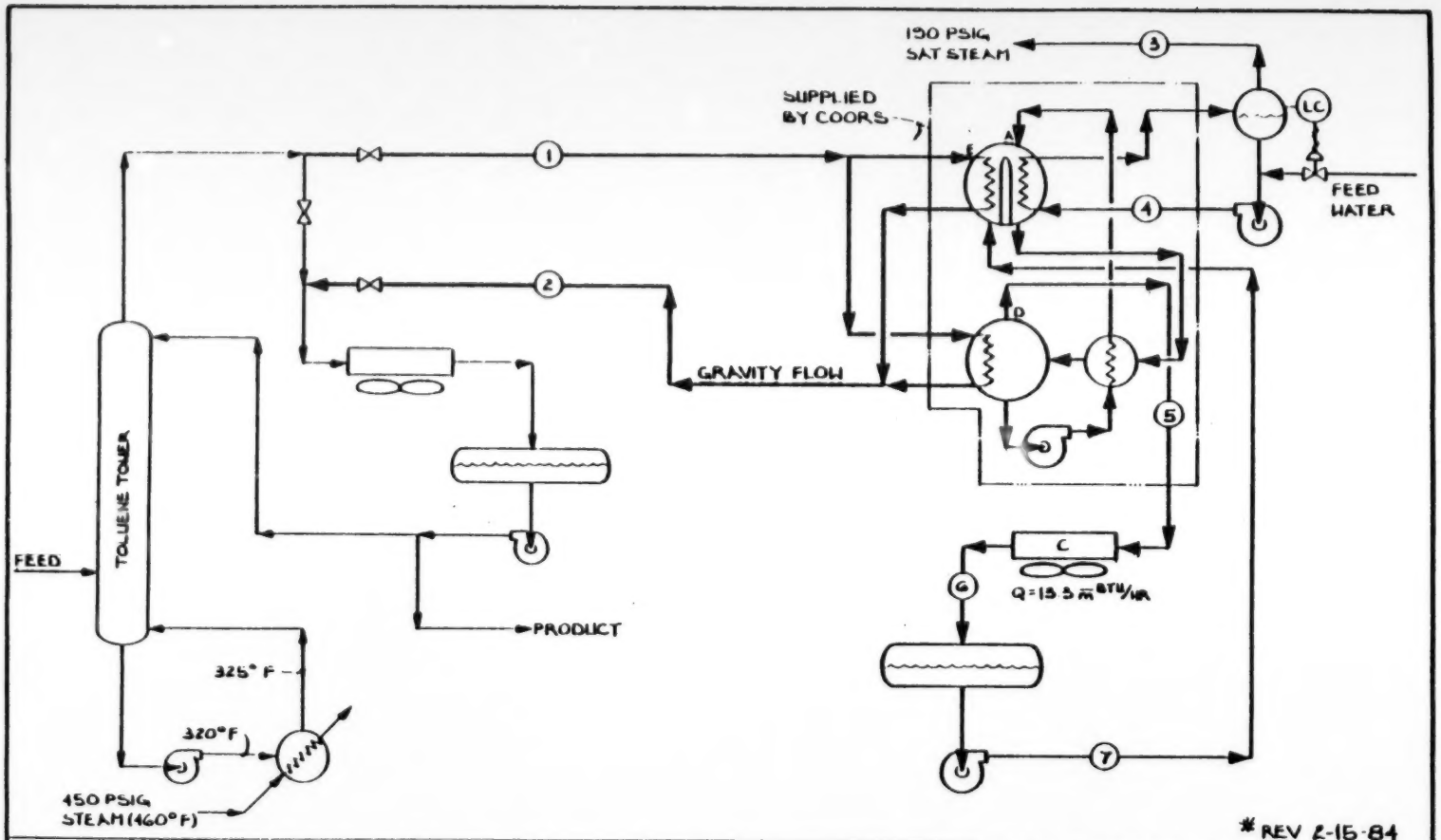
30' Long
20' Wide
15' High

Weight: Approximately

120,000 lb. Dry Shipping
125,000 lb. Operational
281,000 lb. Maximum Full of Water

* This is an 80% by volumn steam to water ratio

76675-2



* REV 2-15-84

LINE NO.	1	2	3	4	5	6	7
MATERIAL	TOLUENE VAPOR	TOLUENE LIQUID	STEAM	WATER	STEAM	WATER	WATER
QUANTITY	166,000#/HR	166,000#/HR	13,300#/HR	* ~427700#/HR	12200#/HR	244 GPM(US)	564 GPM(US)
PRESSURE	6 PSIG	———	190 PSIG	~200 PSIG	13 PSIA	10 PSIA	~35 PSIG
TEMPERATURE	262° F	260° F	384° F	377° F	240° F	110° F	110° F

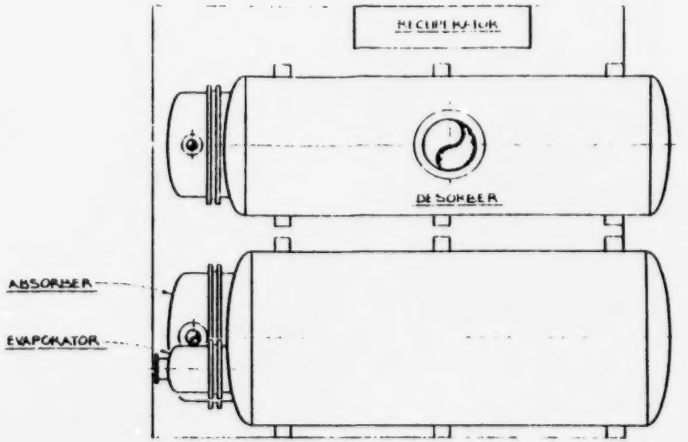
CASE I-DIRECT HEATING

ADOLPH COORS COMPANY

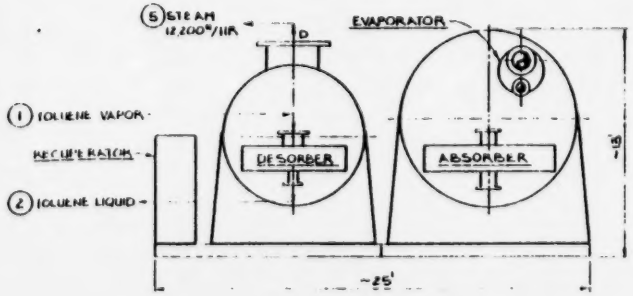
ITB APPLICATION
FOR SUNOCO, SARNIA ONT

APVD L T Whitney DATE 2 14 84

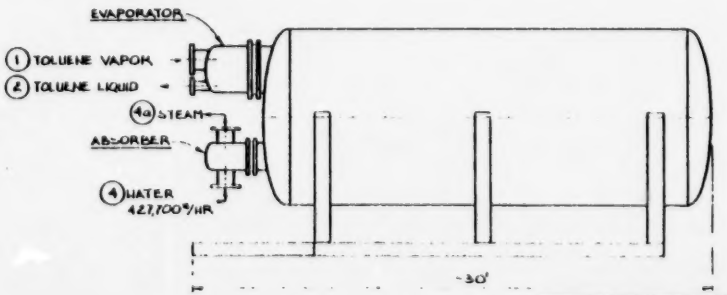
NOZZLE SCHEDULE					
LINE NUMBER	1	2	4	4a	5
NO OF NOZZLES	2	2	1	1	1
SIZE	14"	6"	8"	8"	36"
RATING	150#	150#	300#	300#	150#



PLAN VIEW



END VIEW



ELEVATION

(X) LINE NUMBER SEE PROCESS FLOW DIAGRAM

ADOLPH COORS COMPANY
ITB APPLICATION
FOR SUNOCO, SARNIA ONT
CASE 1 DIRECT SCRUBBING

Coors

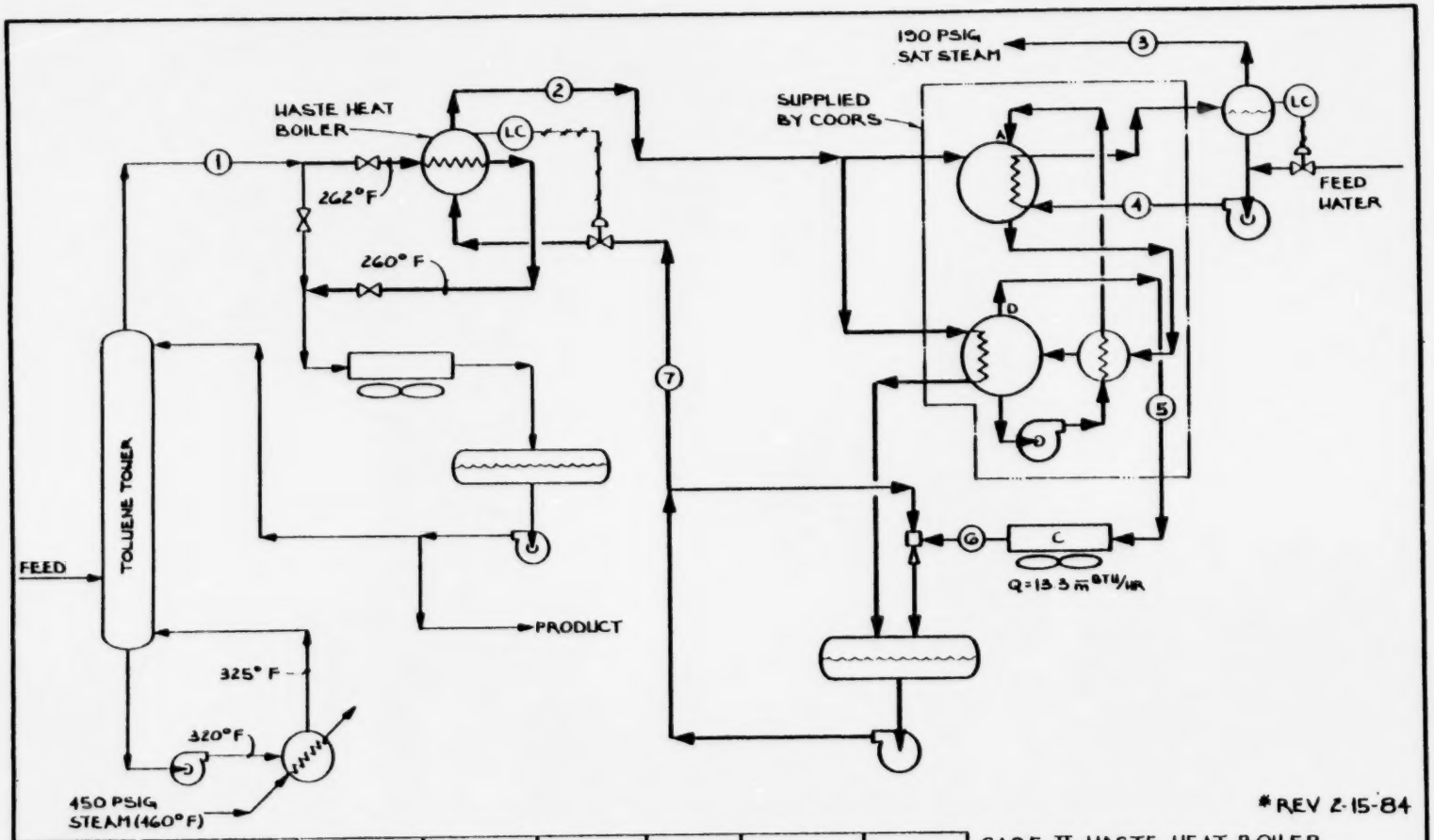
SUNOCO - INDUSTRIAL TEMPERATURE BOOSTER

CASE II - SPECIFICATIONS FOR DESIGN CONDITIONS

Input:	26,600 lb/hour of 250°F Saturated Steam (30psia)
Output:	473,645 lb/hour of saturated water and 13,300 lb/hour saturated steam at 190psig and 384°F. *
	12,200 lb/hour 1.3psia 240°F superheated steam to air cooled condenser.
Utility Requirements:	80psig Instrument Air
	Electrical Power
	25 Horsepower-- Solution Pump
Size:	Approximately
	30' Long 20' Wide 15' High
Weight:	Approximately
	110,000 lb. Dry Shipping 115,000 lb. Operational 271,000 lb. Maximum Full of Water

* This is an 80% by volumn steam to water ratio

76675-1



*REV 2-15-84

LINE NO.	1	2	3	4	5	6	7
MATERIAL	TOLUENE VAPOR	STEAM	STEAM	WATER	STEAM	WATER	WATER
QUANTITY	166,000#/HR	26,600#/HR	13,300#/HR	*~427,700#/HR	12,200#/HR	24.4 GPM(US)	56.9 GPM(US)
PRESSURE	6 PSIG	30 PSIA	190 PSIG	~200 PSIG	1.3 PSIA	1.0 PSIA	~50 PSIG
TEMPERATURE	262° F	250° F	384° F	377° F	240° F	110° F	*~200° F

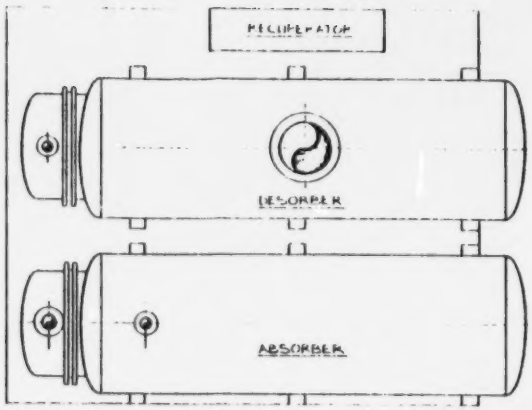
CASE II-WASTE HEAT BOILER

ADOLPH COORS COMPANY

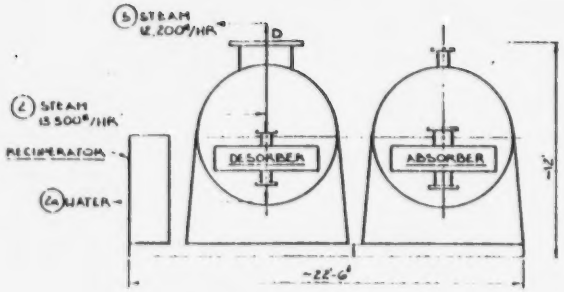
ITB APPLICATION
FOR SUNOCO, SARNIA ONT

APVD [signature] DATE 4 FEB 84

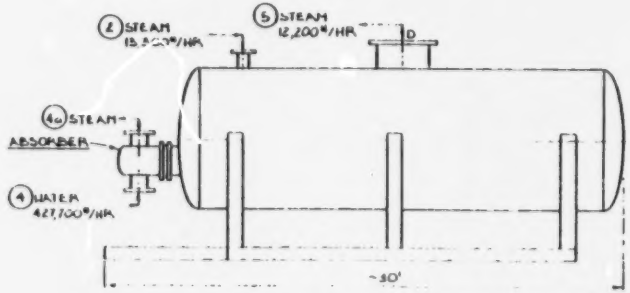
NOZZLE SCHEDULE						
LINE NUMBER	2	4	4a	5	2a
NO OF NOZZLES	2	1	1	1	1
SIZE	6"	8"	8"	36"	2"
RATING	150#	300#	300#	150#	150#



PLAN VIEW



END VIEW



ELEVATION

(X) LINE NUMBER - SEE PROCESS FLOW DIAGRAM

ADOLPH COORS COMPANY
ITB APPLICATION FOR SUNOCO, SARNIA, ONT
[illegible] WASTE HEAT BOILER

Coors

STATEMENT OF WORK - COORS

The following is a listing of equipment, machinery, services and documents which will be provided by Coors to Sunoco as a result of Sunoco's acceptance of this proposal for an ITB as outlined in the "Specifications" section of this proposal.

I. EQUIPMENT INCLUDED:

A. Case I: One (1) complete ITB, skid mounted, consisting of:

1. Shells and bundles comprising the Absorber, Evaporator, Desorber, and Recuperator sections of the ITB designed for 50 psig to full vacuum per ASME code, Section VIII, Div. I and TEMA "R." The Absorber/Evaporator shell and Desorber shells will each have at least one (1) 10" flanged inspection port.

2. One (1) Solution Pump, sized for 120% of normal flow, hermetically sealed with integral explosion proof motors.

3. Interconnecting piping for the solution sections of the ITB, including the internal piping, distributors and spray nozzles. No radiographic testing will be done.

4. Steam tracing for the solution pipes.

5. Isolation, bypass and control valves in the solution lines.

6. Complete instrumentation for the solution section of the ITB.

7. Safety Relief Protection for the Absorber/Evaporator shell and the Desorber shell consisting of a rupture disk on each shell.

8. Insulation and aluminum jacketing for vessels and piping; mineral wool for vessels and Ca-Si block for piping.

9. Structural steel frame for the ITB. Frame will be primed and painted with a shop coat. Frame will be designed for Seismic Zone 1.

10. A system for continually purging the ITB internals of noncondensable gases.

11. Complete charge of Lithium Bromide salt, corrosion inhibitor, wetting agents. Water of condensate quality will be provided by Sunoco.

8. Case II: One (1) complete ITB, skid mounted, consisting of:

1. Shells and bundles comprising the Absorber, Desorber and Recuperator sections of the ITB designed for 50 psig to full vacuum per ASME code, Section VIII, Div. 1 and TEMA "R." The Absorber and Desorber shells will each have at least one (1) 10" flanged inspection port.

2. One (1) each Solution Pump, sized for 120% of normal flow, hermetically sealed with integral explosion proof motors.

3. Interconnecting piping for the solution sections of the ITB, including the internal piping distributors and spray nozzles. No radiographic testing will be done.

4. Steam tracing for the solution pipes.

5. Isolation, bypass and control valves in the solution lines.

6. Complete instrumentation for the solution section of the ITB.

7. Safety Relief Protection for the Absorber shell and the Desorber shell consisting of a rupture disk for each shell.

8. Insulation and aluminum jacketing for vessels and piping; mineral wool for vessels and Ca-Si block for piping.

9. Structural steel frame for the ITB. Frame will be primed and painted with a shop coat. Frame will be designed for Seismic Zone 1.

10. A system for continually purging the ITB internals of noncondensable gases.

11. Complete charge of Lithium Bromide salt, corrosion inhibitor, wetting agents. Water of condensate quality will be provided by Sunoco.

II. SERVICES INCLUDED:

Under the terms of this proposal:

A. Coors designated representative(s) will be present to consult with and provide technical assistance to Sunoco personnel during the setting and reassembly of the ITB.

B. Coors designated representative(s) will direct (with Sunoco's assistance) the cleaning, evacuation, filling and preparation of the ITB prior to start-up.

C. Coors designated representative(s) will determine when the ITB is ready for start-up and oversee the actual start-up and acceptance test as outlined in the "Terms and Conditions."

D. Coors will provide additional services as requested by Sunoco on a reimbursable basis as outlined in the Attachment of this proposal.

III. DOCUMENTATION INCLUDED:

A. Under the terms of this proposal, Coors will provide to Sunoco:

1. Certified P&ID.
2. Certified plan and elevation drawings.
3. Certified electrical one-line diagram.
4. Instrument list.
5. Certified assembly drawings.
6. An operating and maintenance manual.
7. ASME data sheets for pressure vessels provided by Coors.
8. Catalog and manufacturers literature for each purchased item, which will include suggested spare parts lists.

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02/27/84

STATEMENT OF WORK - SUNOCO

The following is a listing of equipment, machinery, services and documents which will be provided by Sunoco or its agent(s) as a result of Sunoco's acceptance of this proposal for an ITB as outlined in the "Specifications" section of this proposal.

Sunoco will:

A. Provide transportation for the ITB from Coors Fabrication Shop to Sunoco's project site.

B. Provide Design and Installation of a suitable foundation slab or base on which to mount the ITB.

C. Offload and set the ITB on its base.

D. Provide the design, equipment, materials and labor required for the completed installation (in either case I or II) which are not provided by Coors as specified in "Statement of Work - Coors". Sunoco is responsible for timely and adequate specification, design and configuration of equipment in this category so as not to cause Coors to significantly change the design and/or equipment in the base ITB unless appropriate compensation is made to Coors. In addition, Coors has the right to review and approve the design, layout and selection of material and equipment for this installation which are done by others.

E. Provide construction labor, tools and materials to assemble the ITB components (as shipped), including finish painting and insulation touch-up and completion.

F. Provide all design, equipment, materials and labor to route and connect:

1. a. Toluene to and from the ITB in Case I.

   b. 30 PSIA dry saturated steam to the ITB in Case II.

2. Feed water to the absorber and steam/water line from absorber to the steam drum.

3. Low-pressure steam line from desorber to air cooled condenser.

4. a. Condensate from air cooled condenser to the evaporate (in Case I).

   b. Condensate line from desorber bundle to condensate accumulator (in Case II).

5. Instrument air supply.

6. Low pressure steam supply for steam tracing.

G. Provide all electrical power for the ITB, including motor starters, S/S stations, conduit and wiring. Lighting, grounding and maintenance/convenience outlets are the responsibility of Sunoco.

H. Purchase, install and calibrate all instruments (transmitters, indicators, converters, controllers, gauges, switches and alarms) for the ITB and peripherals, which are not part of the solution section of the ITB.

I. Provide a supply of condensate-quality water for filling the ITB.

J. Provide low pressure steam (25 psig is suitable) and necessary connections for initial purging of the ITB prior to evacuation and filling.

K. Provide any required fire proofing and/or fire protection.

L. Provide all building or other required permits, inspections or certificates to install and activate the ITB.

M. Provide access to the work site by Coors designated representative(s) as specified in the Terms and Conditions of Sale (paragraph 3).

N. Provide technicians, mechanics and operators to work with Coors designated representatives during the preparation of the ITB for start-up, the start-up and qualification test (see Terms and Conditions of Sale, paragraph 6).

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02/24/84

ADOLPH COORS STANDARD CONDITIONS OF SALE
FOR THE INDUSTRIAL TEMPERATURE BOOSTER

EXCEPT AS OTHERWISE AGREED TO BY ADOLPH COORS COMPANY, (HEREINAFTER "ACCO") IN WRITING, THE FOLLOWING CONDITIONS ARE THE SOLE CONTROLLING TERMS WHICH SHALL APPLY TO ANY ORDER RECEIVED AND ALL SALES MADE BY ACCO FROM SUNOCO INCORPORATED (PURCHASER):

1. DEFINITIONS:

AGREEMENT: This contract of sale between ACCO and Purchaser,

PRODUCT(S): THE INDUSTRIAL TEMPERATURE BOOSTER (HEREINAFTER REFERRED TO AS ITB) and documentation listed in ACCO's Quotation and their component parts, which are deliverable by ACCO under the Agreement.

SPECIFICATIONS: The required inputs and corresponding ITB outputs used in the sizing and design of this ITB which are listed in the "Specifications" section of this Proposal.

STATEMENT OF WORK: The listing of equipment, machinery, services and documents provided to purchaser as detailed in the "Statement of Work" section of this Proposal.

2. RIGHT TO FURNISH EQUIPMENT:

ACCO represents that it is licensed to use, manufacture, fabricate, sell or sublicense others to sell the Industrial Temperature Booster worldwide (excluding Japan).

3. ACCESS TO WORK/TESTING:

Purchaser or his designated representative shall have reasonable access to places of manufacture of the ITB at times convenient to ACCO with prior notification. Purchaser shall, whenever possible, provide three (3) days notice. ACCO shall also notify Purchaser ten (10) work days prior to any test or inspection which Purchaser has specifically advised ACCO that Purchaser wishes to witness.

ACCO and its designated representatives shall have unrestricted access to the installation site during design, construction and startup of the ITB, as well as reasonable access to the installation site for the purpose of performing inspection services after the ITB has been placed in service. Purchaser shall grant ACCO access for a minimum of three (3) inspection trips during the 18 months immediately after the ITB is placed in service.

ACCO shall also have reasonable access to the installation site for the purposes of obtaining and/or reviewing performance data for use in connection with ACCO's marketing and sales efforts for the ITB. Access for marketing and sales purposes shall be at times mutually convenient to ACCO and the Purchaser, but Purchaser shall not unreasonably withhold its consent to such visitations. After startup of the ITB, one marketing and sales visitation will be for the purpose of photographing the installed ITB.

4. DELIVERY:

Delivery of the ITB to Purchaser shall be FOB ACCO's plant. Unless agreed otherwise, ACCO may tender delivery in several lots. ACCO will exercise reasonable efforts to complete delivery of the ITB by the times specified in the ACCO quotation. Upon delivery, title to the ITB and all risks of damage and loss shall pass to Purchaser.

5. STARTUP:

Startup shall be defined as the time when the ITB first produces an average of at least 85% of the specified design quantity of steam for a continuous period of 48 hours; provided, however, that successful startup is contingent upon the Purchaser providing waste heat, condenser cooling and other utilities of the quantity and quality specified by ACCO. In addition, the purchaser or its agent(s) must provide Coors the right to review and approve the design, layout and selection of materials and equipment for this installation which will not be supplied by Coors. The designated ACCO Representative will determine when the ITB is finally installed and ready for startup testing, as well as witness the testing to ensure compliance with proper testing procedures. Waste heat, condenser cooling and utility requirements for performance testing are specified in the Specifications section of this proposal.

6. ACCEPTANCE:

The ITB shall be deemed accepted by Purchaser upon any of the following:

a. Completion of successful "startup" as defined in Paragraph 5 above.

b. If after startup and performance testing, the ITB fails to produce 85% of the specified design quantity of steam for a continuous period of 48 hours, and such failure is not caused in whole or in part by Purchaser's failure to provide waste heat, condenser cooling and other utilities in accordance with the specifications set forth, then ACCO shall provide resources to correct, modify or enhance the ITB components in an effort to achieve the 85% performance level described in Paragraph 5. ACCO's obligation pursuant to this subparagraph shall be limited, however, to providing technical expertise for a period of time not to exceed 90 days from commencement of such corrective efforts and ACCO shall not be obligated to expend more than 10% of the purchase price in an effort to achieve the startup output described in Paragraph 5.

c. If Purchaser is unable to provide waste heat, cooling water and/or other utilities in the quantity and of the quality specified in the Specifications section then acceptance shall be deemed to have occurred upon the date the qualification testing is completed as determined by the designated ACCO Representative.

d. If Purchaser fails or refuses to install the ITB by within 6 months of delivery then acceptance of the ITB shall be deemed to have occurred upon that date.

7. PAYMENT:

a. Purchase price of the ITB, exclusive of taxes, transportation, customs, permits or duties shall be per the attached quotation. In the event ACCO experiences an increase in costs in these areas due to Purchaser's requested changes, ACCO shall be entitled to increase its price appropriately.

b. Payment of the purchase price shall be as follows: 30% of the purchase price due and payable upon execution of this Agreement; 30% of the purchase price upon completion of final P&I and plan and elevation drawings; 35% upon delivery; and the balance of the purchase price upon acceptance.

8. LOSS, DAMAGES OR DELAY:

ACCO shall not be liable for delays caused in whole or in part by circumstances beyond ACCO's reasonable control.

9. NONDISCLOSURE:

Purchaser agrees to hold in confidence and refrain from disclosing to any third person any information or documentation pertaining to the design, configurations, and operating data relating to the internal absorption process of the ITB without first obtaining ACCO's written consent. Such disclosure restriction shall not apply to any portion of such information or documentation which: (a) is or becomes available to the public or generally known in the trade other than as a result of disclosure by Purchaser, its agents or employees or its former agents or employees who have knowledge thereof; (b) is known by or available to Purchaser from any source other than ACCO prior or available to Purchaser from any source other than ACCO prior to Purchaser's receipt thereof from ACCO, prior to Purchaser's receipt thereof from ACCO, or thereafter rightfully becomes known by or available to Purchaser from any such source.

As a condition of this Agreement, Purchaser and its agent(s) or other third parties involved in the design of this ITB installation shall execute ACCO's standard Nondisclosure/Confidentiality Agreement.

10. WARRANTY:

a. ACCO warrants the ITB against defects in materials or workmanship for a period of one year from the date or acceptance. ACCO's sole liability into this warranty shall be repair or replacement of defective materials or correction of defective workmanship during the warranty period.

THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OTHER THAN AS DESCRIBED IN THIS PARAGRAPH.

b. Expressly excluded from the warranty set forth in subparagraph (a) above is any responsibility or liability for deterioration for any part of parts due to corrosion, erosion or flow induced to by vibration on the Purchaser's process side (including but not limited to the waste heat stream, and boiler feed water. Purchaser assumes all risks and responsibility for use of the ITB and for the results obtained by such use.

11. PATENTS:

ACCO is licensed to use and sell certain patented and patentable products and processes as well as certain technical information and knowhow pertaining to a waste-heat recovery system using absorption equipment for temperature augmentation. Acquisition and use of the ITB are subject to those rights, privileges and licenses granted to ACCO. Purchaser therefore expressly agrees that it will refrain from (a) designing, manufacturing or selling a waste-heat recovery system based in whole or in part on the ITB or information and know-how acquired pursuant to this Agreement or (b) disclosing to any person information or documentation obtained pursuant to this Agreement except as provided in Paragraph 9 entitled Nondisclosure, ACCO makes no representations or warranties as to the validity of any of the patents or as to the accuracy, safety or usefulness of any technical information or know-how licensed to ACCO. As part of the consideration for this purchase, purchaser expressly agrees that it will not contest the validity of any patents for waste-heat recovery systems using absorption equipment for temperature augmentation.

12. LIMITATION OF LIABILITY:

ACCO shall be responsible for claims, damages, losses or expenses attributable to bodily injury, including death, or for injury to loss of use or destruction of property only to the extent such claims or losses are proximately caused by ACCO's negligence. ACCO's liability for losses whether claimed in contract, equity, or tort (including negligence) or strict liability shall be limited to an amount not to exceed the contract price for the product(s) sold hereunder. Purchaser's sole and exclusive remedies for breach of warranty or for failure to achieve successful "start-up" shall be those remedies set forth in Paragraphs 6 and 10 entitled ACCEPTANCE AND WARRANTY IN NO EVENT SHALL ACCO BE LIABLE FOR SPECIAL OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF REVENUE, BUSINESS PROFITS, COST OF CAPITAL, CLAIMS OF CUSTOMERS FOR SPECIAL INTERRUPTIONS OR FAILURE OF SUPPLY AND COSTS AND EXPENSES INCURRED IN CONNECTION WITH LABOR OVERHEAD, TRANSPORTATION SUBSTITUTE FACILITIES OR SUPPLY SOURCES.

13. CONTRACT CHANGES:

Changes to the Agreement which affect the scope of, or schedule for, performance by either party, or which alter the form, fit, or function of the Product(s) or any part thereof shall be effected through the following procedure: at anytime during the term of the Agreement, either party hereto may request contract changes by transmitting to the other party a written contract change request ("CCR") which describes the proposed change and defines its effect upon system scope, performance, price, schedule, form, fit and function. Within thirty (30) days of receipt of any CCR, the receiving party will respond in writing to the requesting party by accepting, rejecting, or modifying the request. A response modifying a CCR shall, in turn, require a counter-response within fifteen (15) days of receipt thereof. Each CCR, when agreed to in writing by both parties, shall be effective as a binding amendment to the Agreement. ACCO shall be reimbursed, at then current technical service rates, for evaluating each Purchaser-initiated CCR which, in the reasonable opinion of ACCO, required excessive or extraordinary evaluation effort.

14. TERMINATION:

Purchaser may terminate this Agreement for goods or services only with ACCO's consent. On termination, Buyer shall pay to ACCO reasonable termination charges which shall include an adjustment in the unit price of articles purchased if the quantity purchased is smaller than that originally ordered. Buyer shall also be responsible for all costs incurred by ACCO in connection with the termination, including settlement expenses and attorney fees, if applicable. Termination charges shall include anticipatory profit on the entire order, as adjusted.

15. NOTICES:

All notices and other communications required or permitted will become effective five (5) days after deposit postage prepaid in the official United States mail as registered return receipt requested mail, and addressed to the party at its last known address.

16. TRANSFERS AND ASSIGNMENTS:

Neither party shall transfer or assign any of its rights or obligations under the Agreement without the prior written consent of the other party, except that transfer or assignment may be made by either party to a parent company (including any division, operating unit or wholly-owned subsidiary thereof) or to a successor by way of merger, consolidation or the acquisition of substantially all of the assets of the assigning party, provided the assignee expressly assumes the obligations of assigning party in writing. Any assignment in violation of this Section 16 shall be null and void.

17. GENERAL:

17.1 HEADINGS

The headings and titles to the Agreement are inserted for convenience only and shall not be deemed a part hereof or affect the construction or interpretation of any provision hereof.

17.2 REMEDIES

Unless otherwise expressly provided herein, the rights and remedies hereunder are in addition to, and not in limitation of, other rights and remedies under the Agreement, at law or in equity, and exercise of the right or remedy will not be deemed a waiver of any other right or remedy.

17.3 ENTIRE AGREEMENT

The Agreement supersedes all other agreements, oral or written, heretofore made with respect to the subject hereof and the transactions contemplated hereby and, together with the exhibits hereto, contains the entire agreement of the parties.

17.4 SEVERABILITY

Any provision hereof prohibited by or unlawful or unenforceable under any applicable law of any jurisdiction, may be declared ineffective without affecting any other provision of the Agreement. To the full extent, however, that the provisions of such applicable law may be waived, they are hereby waived, to the end that the Agreement be deemed to be a valid and binding agreement enforceable in accordance within its terms.

17.5 SUCCESSORS AND ASSIGNS

The provisions of the Agreement shall be binding upon and inure to the benefit of ACCO and Purchaser and their respective successors and assigns. This provision shall not be deemed to expend or otherwise affect the limitations on assignment and transfers set forth in the Agreement and no party is intended to or shall have any right or interest under the Agreement, except as specifically provided for herein.

17.6 MODIFICATIONS-WAIVERS-CHANGES

No cancellation, modification, amendment, deletion, addition or other change in the Agreement or any provision hereof, or waiver of any right or obligation herein provided shall be effective for any purpose unless specifically set forth in writing and signed by the party to be bound thereby. Waiver of any right or remedy in respect of any

occurrence or event on one occasion shall not be deemed a waiver of such right or remedy in respect of such occurrence or event on any other occasion.

17.7 REMEDIES FOR BREACH

In the event ACCO resorts to court action or arbitration to enforce any provisions herefore as breach of Purchaser, ACCO shall be entitled to recover its costs and attorneys' fees incurred in connection with such action.

17.8 CONTROLLING LAW

All questions concerning the validity and operation of the Agreement and the performance of the obligations imposed upon the parties hereunder shall be governed by the laws of the State of Colorado. Exclusive jurisdiction over any dispute arising out of this Agreement shall be in the Jefferson County District Court, Jefferson County, Colorado.

18. ORDER OF PRECEDENCE:

Unless otherwise stipulated, determinations of responsibilities or clarification of conflicts under this Agreement shall be resolved by utilization of the following order of precedence:

a. Specifications
b. Statement of Work
c. Standard Conditions of Sale

BY SIGNING BELOW, the parties hereto acknowledge and accept the conditions of sale set forth herein.

ADOLPH COORS COMPANY

By _____

Title _____

Date _____

SUNOCO INC.

By _____

Title _____

Date _____

PRoybal/jhc:4031A
02/27/84

APPENDIX A

Certificate of Successful Startup

This is to certify that on _____, 19____, the ITB was successfully started up or available for successful startup and thus accepted by Purchaser as satisfying the functional requirements as outlined in Agreement _____, Paragraph 5.0.

ACCO_____

PURCHASER_____

APPENDIX B

Certificate of Delivery

This is to certify that delivery of equipment, referred to as the Industrial Temperature Booster, was effected for Purchaser by ACCO on _____, 19___.

This date shall act as initiating a one-year guarantee for defects in material and workmanship as outlined in Agreement _____, Paragraph 10. This warranty shall be in effect until _____, 19___.

ACCO_____

PURCHASER_____

Coors

QUOTATION

The Adolph Coors Company will provide one (1) ITB to Sunoco Inc. per the Specifications, Statement of Work, and Terms and Conditions of Sale included with this proposal for the total sum of:

A.	Case I	$853,535
B.	Case II	$783,053

As described in "Terms & Conditions of Sale" these prices are F.O.B. Golden, Colorado and do not include taxes, transportation, customs, permits, local inspections or duties.

These prices are firm through April 30, 1984.

This quotation will be withdrawn by Coors if the Canadian Government, in sponsoring this study and installation, or any agent of Sunoco will not agree to and abide by the non-disclosure clause (Item 9) of the terms and condition of sale.

The Certified P & ID, Plan and Elevation Drawing and Electrical One-Line Diagram will be sent to Sunoco 4 weeks after receipt of purchase order.

The ITB will be delivered 30 weeks after approval by Sunoco of these drawings.

LWhitney/bar:4028A.6
02/24/84

ATTACHMENT

REIMBURSIBLE RATE SCHEDULE

In the event Ashland Petroleum requests services of Coors beyond those included with this proposal, those services will be invoiced to Ashland at the following rates:

Hourly Billing Rates Classification	Rate Per Hour Regular	Overtime
Project Manager	$70.00	$70.00
Engineering Manager	70.00	70.00
Engineering Supervisor	62.50	62.50
Engineer V	62.50	62.50
Engineer IV	50.80	50.80
Engineer III	45.00	45.00
Engineer II	40.00	40.00
Engineer I	35.00	35.00
Designer II	40.00	40.00
Designer I	35.00	35.00
Drafter III	33.00	49.50
Drafter II	30.00	45.00
Technician	53.00	53.00
Clerical	27.00	40.50
Word Processing Specialist	25.00	37.50

Other Direct Costs	
Auto	$ .25 per mile
Rental Vehicles	Invoice cost + 10%
Air Travel	Invoice cost + 10%
Employee Travel Expenses	Cost + 10%
Other Job-related Expenses	Cost + 10%
Outside Consultants and Subcontractors	Invoice cost + 10%

This rate schedule is effective through December 31, 1984. If contract extends beyond that date, a new rate schedule will be added to the contract.

APPENDIX - H

SUMMARY OF BIDS

STEARNS CATALYTIC

CLIENT: Department of Supply & Services Canada
PROJECT: Cowan Heat Exch
EQUIPMENT: Industrial Temperature Monitor
MATERIALS:
TAG NO:
PROJECT NO: 2432-1
DESCRIPTION AND/OR SERVICE (END USE)
SHEET 1 OF

Fig	BIDDERS NAME / MANUFACTURERS NAME		Adolph Case I	Coors Company (Proprietary Equipment)		Case II (Modified) - See Quote		S.C.L. "ESTIMATE" VALUE
1	QUOTATION REFERENCE NUMBER							
2	QUOTATION EXPIRY DATE		30'x 20' x 16'					
3								
4	Industrial Temperature Monitor		783,635.00 US			783,053.00 US		
5	Skid Mounted Sampling etc							
6	Shells and bundles for cooler etc							
7	Absorber, Evaporator Detacher							
8	one Refrigerator							
9	One solution Pump							
10	Instrumentation Piping							
11	Steam Tracing for solution Pipes							
12	Isolation, Bypass and Control Valves							
13	Complete instrumentation for solution units							
14	Safety Relief for Absorber/Evaporator							
15	Insulation & Al Jacketing for vessels							
16	Structural Steel Frame for ITM							
17	Continuously purging bubbler for interface							
18	Charge of salts							
19								
20	Base Price US Dollars		783,635.00			783,053.00		
21	Exchange @ 25%		213,383.75			195,763.25		
22			1,066,918.75			978,816.25		
23	Duty @ 12.1%		129,097.17			118,436.79		
24	Lot Price Canadian		1,196,015.92			1,097,253.04		
25	Estimated Freight		13,000.00			13,000.00		
26	Estimated Brokerage		500.00			500.00		
27								
28								
29	TIME REQUIRED TO SUBMIT DRAWING		—					
30	BASE PRICE		—					
31	SHIPPING/F.O.B. POINT		Golden, Colorado					
32	WEIGHT/FREIGHT		120,000 lb			110,000		
33	FUNDS (CURRENCY)/DUTY		See Above					
34	EXCHANGE/BROKERAGE		See Above					
35	FEDERAL/PROVINCIAL SALES TAX		Exempt					
36	EXPORT PACKING		—					
37	TERMS OF PAYMENT		Progressive	30% With Order, 30% on		First Day	35% on delivery, 5% on	Acceptance
38	FIRM PRICE/ESCALATION		Firm Till April 30, 1974					
39	DELIVERY PROMISED		32 weeks ADA					
40	BID DATE AND ACCEPTANCE							
41	TOTAL PRICE AT DESTINATION		1,209,515.92			1,109,753.04		

INQUIRY NO: 2432-1
SPECIFICATION NO.:

NOTES

(1) CROSSED "Ø" ITEMS ARE UNDESIRABLE OR DO NOT MEET SPECIFICATIONS
(2)

COMMERCIAL ANALYSIS

REMARKS

RECOMMENDED BIDDER
COLUMN NO ... BY JP ... DATE Feb-05-73
REASONS

TECHNICAL ANALYSIS

REMARKS

RECOMMENDED BIDDER
COLUMN NO ... BY ... DATE ...
REASONS

SELECTED SUPPLIER

NAME ... COLUMN NO
REASONS

APPROVAL OF SELECTED SUPPLIER

S.C.L. ... DATE
... DATE
CLIENT ... DATE
... DATE

FORM NO. SCP 000

IMPORTANT: WHEN SELECTED SUPPLIER TOTAL PRICE EXCEEDS S.C.L. "ESTIMATE" VALUE BY $1000 OR MORE FORM NO. PC-004 MUST BE COMPLETED AND APPROVED

SUMMARY OF BIDS

STEARNS CATALYTIC

CLIENT: Department of Supply & Services Canada
PROJECT: Success Indicator Temperature Booster
EQUIPMENT MATERIALS: C.S. Vessels
TAG NO V-1 & V-2
PROJECT NO 2432-2
SHEET ___ OF ___
DESCRIPTION AND/OR SERVICE (END USE)

Tag	BIDDERS NAME / MANUFACTURERS NAME	O'Connor Tanks / Toronto	MacKenzie Block / Cayuga	Great Lakes Fabricating / Sarnia	Chemical Valley / Sarnia	Sarnia Tank / Sarnia	Toronto Tubesheet / Toronto	SCI "ESTIMATE" VALUE
1	QUOTATION REFERENCE NUMBER							
2	QUOTATION EXPIRY DATE							
3								
4	Tag V1							
5	Horizontal Steam Drum	8575.00	10,400.00	13,905.00	14,070.00	16,248.00	17,200.00	
6	4'-0" Φ x 12'-0" long							
7								
8	Tag V2							
9	Horizontal Condensate Drum	3194.00	5,660.00	5743.00	7,169.00	7,920.00	9000.00	
10	2'-6" Φ x 8'-0" long							
11								
12								
13								
14								
15								
16								
17	Weight							
18	V1	7100 lb	4500 lb	—	7500 lb	7500 lb	6400 lb	
19	V2	1661 lb	Enclosed	—	3000 lb	2400 lb	1200 lb	
20								
21								
22		Non-Union	Union	Union	Union	Union	Union	
23								
24								
25								
26								
27								
28								
29	TIME REQUIRED TO SUBMIT DRAWING							
30	BASE PRICE	11,779.00	15,960.00	19,647.00	21,239.00	24,168.00	26,200.00	
31	SHIPPING/F.O.B. POINT	Toronto	Cayuga	Sarnia	Sarnia	Sarnia	Sarnia	
32	WEIGHT/FREIGHT	TOA	TOA	Included	TOA	TOA	150.00	
33	FUNDS (CURRENCY)/DUTY	—	—	—	—	—	—	
34	EXCHANGE/BROKERAGE	—	—	—	—	—	—	
35	FEDERAL/PROVINCIAL SALES TAX	Exempt	Exempt	Exempt	Exempt	Exempt	Exempt	
36	EXPORT PACKING	—	—	—	—	—	—	
37	TERMS OF PAYMENT	Net 30	Net 30	Net 30	Net 30	Net 30	Net 30	
38	FIRM PRICE/ESCALATION	Firm	Firm	Firm	Firm	Firm	Firm	
39	DELIVERY PROMISED	6-8 wks ADA	12 wks ADA	7 wks ADA	7 wks ADA	6-7 wks ADA	12-14 wks ADA	
40	BID DATE AND ACCEPTANCE 1 wk Discount	—	—	—	—	—	(1310.00)	
41	TOTAL PRICE AT DESTINATION			19,647.00			25,040.00	

INQUIRY NO 2432-2
SPECIFICATION NO *

NOTES

(1) CROSSED "@" ITEMS ARE UNDESIRABLE OR DO NOT MEET SPECIFICATIONS
(2)

COMMERCIAL ANALYSIS

REMARKS

RECOMMENDED BIDDER ___
COLUMN NO ___ BY ___ DATE ___
REASONS

TECHNICAL ANALYSIS

REMARKS

RECOMMENDED BIDDER O'Connor Tanks
COLUMN NO ___ BY [signature] DATE 12 Mar 84
REASONS Low Bid

SELECTED SUPPLIER

NAME ___ COLUMN NO ___
REASONS

APPROVAL OF SELECTED SUPPLIER

SCI [signature] DATE 12 March
___ DATE ___
CLIENT ___ DATE ___
___ DATE ___

IMPORTANT: WHEN SELECTED SUPPLIER TOTAL PRICE EXCEEDS SCI "ESTIMATE" VALUE BY $1000.00 OR MORE FORM NO PC-604 MUST BE COMPLETED AND APPROVED

SUMMARY OF BIDS

STEARNS CATALYTIC

CLIENT: Department of Supply & Services
PROJECT: Success Heat Plant
EQUIPMENT MATERIALS: Air Cooled Exchangers

TAG NO. AC-1 PROJECT NO 2422 SHEET 1 OF

DESCRIPTION AND/OR SERVICE (END USE) Steam Condenser

INQUIRY NO 2432-3 SPECIFICATION NO

	BIDDERS NAME	Keepright	GEA	Combustion
	MANUFACTURERS NAME	Unifin	Ramey	Engineering
1	QUOTATION REFERENCE NUMBER	London	Cochrane Alt	
2	QUOTATION EXPIRY DATE			
3				
4	Steam Condenser 12 fil			
5	33' x 40' Plot Area			
6	12,700 lb/hr			
7				
8	Lot Price	255,350.00	264,820.00	305,600.00
9				
10				
11	Wrap on Fins in lieu of Integral	(5700.00)	—	—
12				
13				
14	Weight	176,000 lb	148,000 lb	154,000 lb
15				
16	Draft	Induced	Forced	Forced
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29	TIME REQUIRED TO SUBMIT DRAWING	—	—	—
30	BASE PRICE	251,350.00	264,820.00	305,600.00
31	SHIPPING/F.O.B. POINT	London	Kitchener	Cornwall
32	WEIGHT/FREIGHT	1000.00	1000.00	1500.00
33	FUNDS (CURRENCY)/DUTY	—	—	—
34	EXCHANGE/BROKERAGE	—	—	—
35	FEDERAL/PROVINCIAL SALES TAX	Exempt	Exempt	Exempt
36	EXPORT PACKING	—	—	—
37	TERMS OF PAYMENT	Net 30	Progressive	Progressive
38	FIRM PRICE/ESCALATION	Firm	Firm	Firm
39	DELIVERY PROMISED	20-24wks ARO	16-20wks ADA	22wks ADA
40	BID DATE AND ACCEPTANCE			
41	TOTAL PRICE AT DESTINATION	254,350.00	264,820.00	305,100.00

SCL "ESTIMATE" VALUE

NOTES

(1) CROSSED "⊗" ITEMS ARE UNDESIRABLE OR DO NOT MEET SPECIFICATIONS
(2)

COMMERCIAL ANALYSIS

REMARKS

RECOMMENDED BIDDER Keepright Unifin
COLUMN NO 1 BY [illegible] DATE [illegible]
REASONS Low bidder in spec

TECHNICAL ANALYSIS

REMARKS

RECOMMENDED BIDDER Keepright -
COLUMN NO 1 BY [illegible] DATE [illegible]
REASONS Low Bid - deduct $700.00 and use wrap on fins. ALSO ADD $1,940 FOR VIBRATION SWITCHES - PER

SELECTED SUPPLIER

NAME COLUMN NO
REASONS

APPROVAL OF SELECTED SUPPLIER

SCL [illegible] DATE [illegible]
DATE
CLIENT DATE
DATE

IMPORTANT: WHEN SELECTED SUPPLIER TOTAL PRICE EXCEEDS S.C.L. "ESTIMATE" VALUE BY $500.00 OR MORE FORM NO. IN 004 MUST BE COMPLETED AND APPROVED

SUMMARY OF BIDS

STEARNS CATALYTIC

CLIENT: Department of Supply & Services Canada
PROJECT: Seneca Heat Pump
EQUIPMENT: Centrifugal Pumps
MATERIALS:

TAG NO: P-1 P3
PROJECT NO: 2452
SHEET 1 OF 1
DESCRIPTION AND/OR SERVICE (END USE)

	BIDDERS NAME							SCL "ESTIMATE" VALUE
	MANUFACTURERS NAME	Canada	Blower / Canada Pump			(3)	(4)	
1	QUOTATION REFERENCE NUMBER							
2	QUOTATION EXPIRY DATE							
3								
4	Tag P2 Water Circulation Pump	$5,489.00		$5489.00		5483.00	5482.00	
5	400° Water Service							
6								
7	3 HP 4 Pole at 25 HP		99.00 - Rec'd			99.00	99.00	
8	Non Witness Hydro test (SPT)		946.00 - NOT Rec'd					
9	Cost from Impeller		(150.00) - NOT Rec'd					
10		Case I		Case II		CASE I	CASE II	
11		150°F		250°F				
12	Tag P3 Condensate Pump	2743.00		3334.00		2743.00	3284.00	
13								
14	Non Witness Hydro test (SPT)		618.00 - NOT Rec'd		(618.00 NOT Rec'd)			
15	Cost from Pump Casing		(326.00) - Rec'd			(275.00)		
16	Gasket Laboratories Mating Flange		(96.00) - NOT Rec'd					
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29	TIME REQUIRED TO SUBMIT DRAWING							
30	BASE PRICE	$2238.00		$3334.00				
31	SHIPPING/F.O.B. POINT	Kitchener		Kitchener				
32	WEIGHT/FREIGHT	176.00		176.00		175.00	175.00	
33	FUNDS (CURRENCY)/DUTY	—		—				
34	EXCHANGE/BROKERAGE	—		—				
35	FEDERAL/PROVINCIAL SALES TAX	Exempt		Exempt				
36	EXPORT PACKING	—		—				
37	TERMS OF PAYMENT	Net 30		Net 30				
38	FIRM PRICE/ESCALATION	Firm		Firm				
39	DELIVERY PROMISED	12-14 WKS		12-14 WKS				
40	BID DATE AND ACCEPTANCE							
41	TOTAL PRICE AT DESTINATION	$407.00		$444.00		$8131.00	$8972.00	

BIDQUIRY NO: C-432-4
SPECIFICATION NO: ANSI

NOTES

(1) CROSSED "Ø" ITEMS ARE UNDESIRABLE OR DO NOT MEET SPECIFICATIONS
(2)

COMMERCIAL ANALYSIS

REMARKS

RECOMMENDED BIDDER: Canada Pump
COLUMN NO: (3) BY: PJD DATE: Mar 23/84
REASONS

TECHNICAL ANALYSIS

REMARKS: Pump P-2 - Base price + 50 HP motor + Bronze Impeller
Pump P-3 CASE I - Base price + Project cost - C.I case with oil lube
CASE II - As is
NO EXTRA COSTS FOR TESTS - BOTH Pumps
RECOMMENDED BIDDER: CANADA PUMP
COLUMN NO: 4&6 BY: (E) DATE: 3/19/84
REASONS

SELECTED SUPPLIER

NAME: CANADA PUMPS COLUMN NO: 4 & 6
REASONS

APPROVAL OF SELECTED SUPPLIER

SCL: PJD DATE
DATE
CLIENT DATE
DATE

IMPORTANT! WHEN SELECTED SUPPLIER TOTAL PRICE EXCEEDS SCL "ESTIMATE" VALUE BY $1000 OR MORE FORM NO PC 004 MUST BE COMPLETED AND APPROVED

SUMMARY OF BIDS

STEARNS CATALYTIC LTD

CLIENT Department of Supply & Services
PROJECT Service Heat Comp.
EQUIPMENT MATERIALS 12" Ins. Kettle
TAG NO 11-1
DESCRIPTION AND/OR SERVICE (END USE) Waste Heat Boiler
PROJECT NO 2432
SHEET OF

Qty	BIDDERS NAME / MANUFACTURERS NAME	Tranter Toronto	J.H. Lock Toronto	Mirabeau					SCL ESTIMATE VALUE
1	QUOTATION REFERENCE NUMBER			Note 1					
2	QUOTATION EXPIRY DATE								
3									
4	Kettle (Complete) Inc. C.	105,600.00	158,000.00						
5	Type 12 H								
6	Spare Gasket	300.00							
7									
8	Weight	68,900 lb	92,000 lb						
9									
10	U Tube Bank Steel Refractory	[6300.00]	—						
11									
12									
13									
14	Alternate - 2 Shells	[131,200.00]	[172,000.00]						
15	Spare Gasket	[200.00]	—						
16	Weight	71,600 lb	90,000 lb						
17	Fee for	[1200.00]	—						
18	U Tube Bank Steel Refractory	[5120.00]	—						
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29	TIME REQUIRED TO SUBMIT DRAWING	—	—						
30	BASE PRICE	126,700.00	158,000.00						
31	SHIPPING/F.O.B. POINT	Toronto	Toronto						
32	WEIGHT/FREIGHT	900.00	900.00						
33	FUNDS (CURRENCY)/DUTY	—							
34	EXCHANGE/BROKERAGE	—							
35	FEDERAL/PROVINCIAL SALES TAX	Exempt	Exempt						
36	EXPORT PACKING	—	—						
37	TERMS OF PAYMENT	Progressive	Progressive						
38	FIRM PRICE/ESCALATION	Firm	Firm						
39	DELIVERY PROMISED	7-9 wks ARO	12-14 wks ARO						
40	BID DATE AND ACCEPTANCE	—	—						
41	TOTAL PRICE AT DESTINATION	106,700.00	158,900.00						

INQUIRY NO 2432-5
SPECIFICATION NO

NOTES
(1) CROSSED "Ⓧ" ITEMS ARE UNDESIRABLE OR DO NOT MEET SPECIFICATIONS
(2)

COMMERCIAL ANALYSIS

REMARKS

RECOMMENDED BIDDER Tranter
COLUMN NO — BY Typ DATE 24 03 14
REASONS

TECHNICAL ANALYSIS

REMARKS

RECOMMENDED BIDDER
COLUMN NO — BY — DATE
REASONS

SELECTED SUPPLIER

NAME COLUMN NO
REASONS

APPROVAL OF SELECTED SUPPLIER

SCL DATE
DATE
CLIENT DATE
DATE